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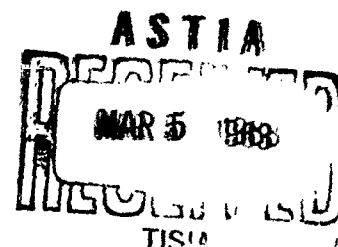
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NOLTR 61-106

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TEST SET, DROP SHOCK, WOX-126A



20 NOVEMBER 1962

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UNITED STATES NAVAL ORDNANCE LABORATORY, WHITE OAK, MARYLAND

NOLTR 61-106

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NOLTR 61-106

TEST SET, DROP SHOCK,  
WOX-126A

Prepared by:

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Environment Simulation Division

ABSTRACT: The report describes a portable 70-inch, free-fall drop tester, presents operating instructions, and contains calibration curves. The tester is an adaptation of the Mk 209 Mod 0 Test Set, which it replaces. A wide range of shocks is produced with felt, rubber, and plastic shock pads. At maximum drop height and for payloads of 1 lb., shocks range in amplitude from 170 g for the softest pad to 3200 g for the hardest pad. The durations of these shocks are 12 ms and 0.6 ms respectively. The maximum allowable load for the test set is 4 lb. For a 4-lb. payload the maximum impact velocity change experienced by the carriage is 35 fps. The report includes complete drawings on the WOX-126A Test Set and calibration information on the Mk 209 Mod 0.

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Test Set, Drop Shock, WOX-126A

The WOX-126A Tester is not a new design; it is a modification of the Test Set Mk 209 Mod 0. The original Mk 209 structure is unchanged; only the drop-height scale, the test carriage and its stopping device have been replaced, and several work-saving devices have been added. The WOX-126A parts are interchangeable with the Mk 209 parts to permit continued use of the tester for Mk 209 applications. It is intended that the Mk 209 Mod 0 Test Set be eventually phased out and that it be replaced by the WOX-126A for ordnance use. The WOX-126A is an experimental tester and is expected to undergo further changes in keeping with its possible use in future ordnance specifications.

Improvements on the Mk 209 Tester were made on a project-need basis over the last two years. The work was supported by projects HASP, FAME 04002, RUSD 2A 001, RUDC 2C 624, NOL 417, SUCCESS, POLARIS Mk 2, and SUBROC.

R. E. ODENING  
Captain, USN  
Commander

*V. M. Korty*  
V. M. KORTY  
By direction

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TEST SET, DROP SHOCK, WOX-126A

INTRODUCTION

Background

1. Original testers: The 126-A Test Set is an adaption of a shock tester designed nearly 20 years ago by the National Bureau of Standards and later designated as the JAN-S-44 "Shock Testing Mechanism" - the tester continues to be specified for standard tests on electronic and electrical component parts (reference (a), Method 202A, Shock). The JAN-S-44 Tester was modified in 1950 by NOL to increase its shock output for testing mine and depth charge components. The design permits continued use of the tester for MIL-STD-202B applications by making the impact springs interchangeable. The drop tester is designated as the Test Set Mk 209 Mod 0, reference (b).

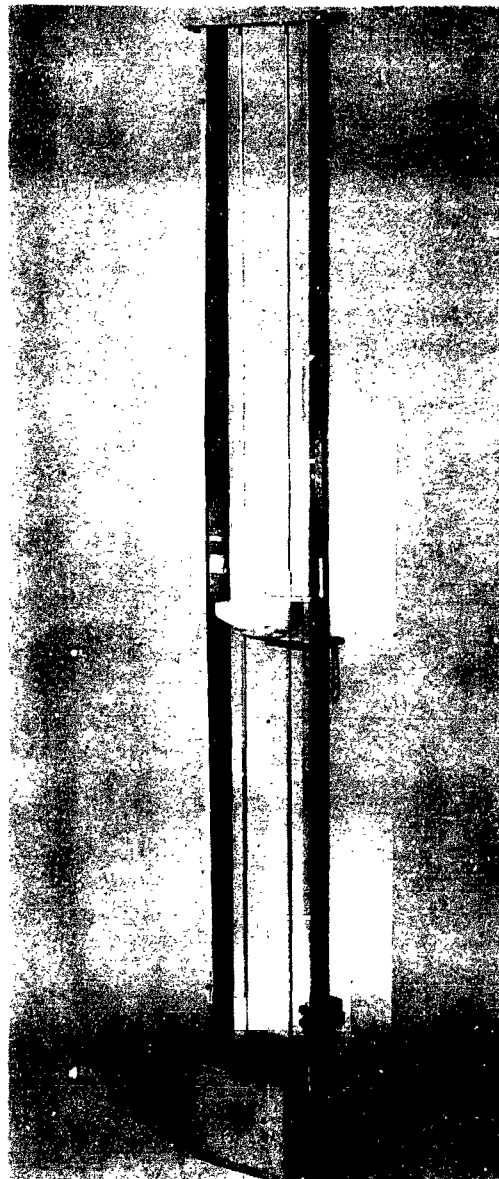


Fig 1  
WOX-126A Test Set

2. New Capability: The JAN-S-44 and Mk 209 Mod 0 Testers are primarily for standard tests to screen components for resistance to shock. The new tester, Fig. 1, provides the capability needed to adequately conduct component design tests where it is necessary to determine the mechanism of shock failure, and for inertia-sensitivity tests, reference (c), where shock parameters must be varied over a wide range to determine the quantitative performance of inertially actuated devices. Also, the increased accuracy of the tester makes it an ideal instrument for calibrating shock recording pickups. The unit-construction carriage has considerably improved the shock pulse characteristics of the tester, and its light weight has reduced impact floor loads.

## DESCRIPTION

General

3. Interchangeability: The 126A changes do not compromise the original Mk 209 design or its capability. All parts are compatible and interchangeable with the Mod 0 to permit the use of both testers. For convenience, Mod 0 characteristics and calibration curves are presented in Appendix A. Changeover to WOX-126A can be done easily and parts are relatively low cost. The interchangeable parts are the test carriage, the shock pads (interchangeable with the Mod 0 anvil) and the drop-height scale. The original structure of the Mk 209 Test Set remains unchanged — see reference (d).

4. Basic Components: The tester consists of a heavy iron base, a lightweight channel structure supporting two vertical guide rods, a lightweight test carriage designed to slide freely along the guide rods, interchangeable shock pads on which the carriage is dropped, shock pad clamps and a 6 ft drop-height scale. A trigger, parts kit, nut driver, straps and clamps are optional. These items are intended to reduce setup time and eliminate the need for hand tools. The tester rests on a 5/16-in. "Isomode" pad to minimize floor loads and prevent shock feedback.

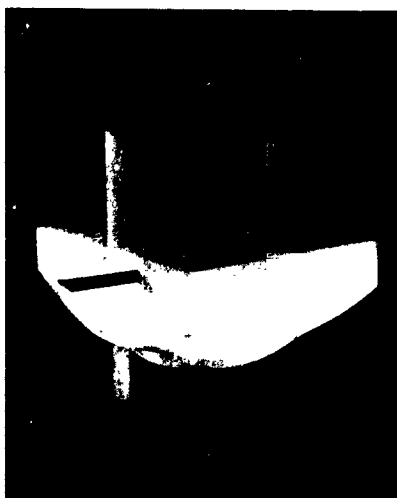


Fig. 2  
Test Carriage

5. Specifications: The drop tester weighs approximately 180 lb., has a 9 3/4 in. by 7 1/2 in. base, and is 87 1/2 in. high. The machine is designed to handle payloads up to 4 lb, with dimensions up to 3 3/4 in. in diameter and 3 1/2 in. high. Other dimensional details may be found in Appendix B.

Component Details

6. Since the essential parts of the tester consist of the test carriage and the shock pads, these will be discussed in detail; for details on the remainder of the parts, see Appendix B.

7. Test Carriage: The Test Carriage, Fig. 2, is constructed of MIL-N-18352 nylon plastic primarily because the material is lightweight and has good resilient characteristics. The carriage has a 5 in. by 6 in. mounting surface and provides enough head space, at a drop height of 70 in., to mount a test object 3 1/2 in. high. For objects higher than this the drop



height is reduced accordingly. The convex striking surface of the carriage is designed to increase stiffness and to prevent impact effects (spurious carriage oscillations)—repeatable flat impacts are at best difficult and tend to excite even the stiffest structure into wild oscillation.

8. Shock Pads: Four shock pads have been standardized for the drop tester to cover a practical range of shock parameters. The soft pads (under 1000 g) are fabricated from 75- to 80- durometer rubber and 70- to 72 -durometer felt (Western Felt Works #196 or equal). The hard pads (over 1000 g) are fabricated from MIL-N-18352 nylon plastic and 40- to 45-

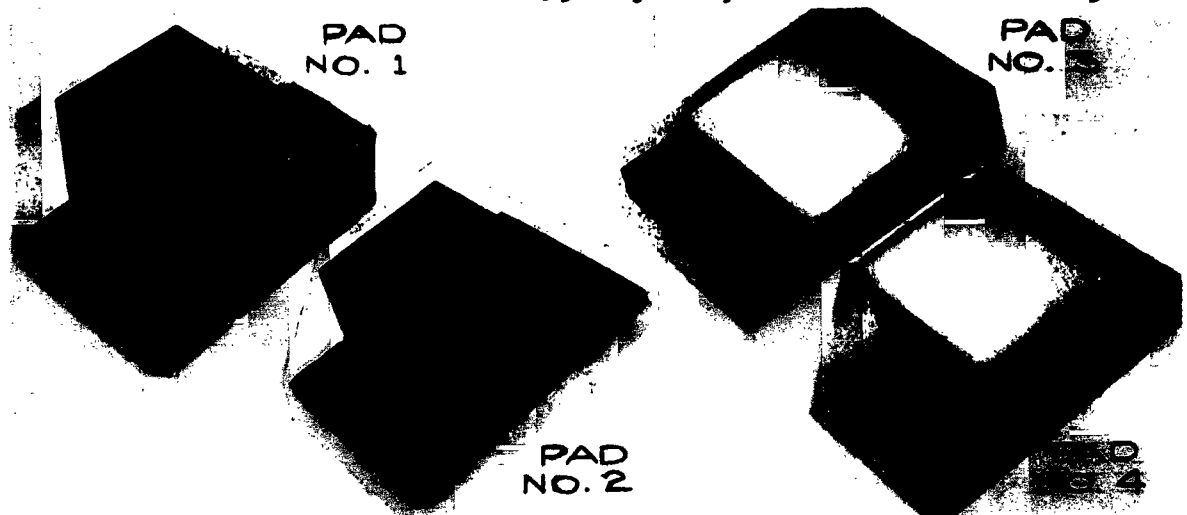


Fig. 3 Shock Pads

durometer rubber. The four types of shock pads are shown in Fig. 3. Briefly, they are as follows:

Pad No. 1 - Rubber with a 1.5 in. hole normal to the direction of impact. The hole reduces the stiffness of the pad to produce a low-g, long-duration pulse.

Pad No. 2 - Rubber with a hard felt core. Rubber prevents dishing in of the striking surface (a problem with felt); felt increases resilience and mitigates pad impact effects (solid rubber causes carriage oscillations).

Pad No. 3 - Rubber, topped with a thin nylon plastic plate. Solid nylon plastic is too stiff under pure compressive impact to produce shocks in the 1000-g range and thin rubber under pure compressive impact mutilates at 1000-g loading. Combining the two materials produced the desired shock parameters.

Pad No. 4 - Solid nylon plastic. This pad is designed to give the maximum shock output for the tester (highest velocity change and acceleration).

#### INSTALLATION OF WOX-126A PARTS

9. A number of Mk 209 Mod 0 Test Sets are currently in use and others are available on loan to DOD agencies and contractors through the Bureau of Weapons. For this reason the following "do it yourself" instructions for the installation of new parts are presented. Except for several holes which must be tapped in the frame of the Test Set, the modifications do not deface or change significantly the original Tester. Refer to Appendix B for the list of parts and drawings.

10. Drop-Height Scale. To install the drop-height scale place the tester on its back and tape the scale to the left column so the end of the scale is 6 in. above the base as shown in Fig. 4. Drill and tap two 4-40 holes in the column using the bottom of each slot in the scale to locate the holes.



Fig. 4 Scale Installations



Fig. 5 Scale Clamp

11. Scale Clamps: To prevent the scale from curling at the ends a pair of clamps have been provided, see Fig. 5. The screws which tighten the clamps need only be brought up snug - forcing them may cause the clamps to break or strip the threads in the screws.

12. Mod 0 Carriage and Anvil: To remove the Mod 0 carriage loosen the guide rod nuts as shown in Fig. 6 (use the nut driver furnished) and loosen the nuts at the base of the rods — these may be discarded. Unscrew the rods and remove the Mod 0 carriage. Unscrew anvil bolts and remove the anvil.

13. Shock Pad Studs and Clamps: Before installing the WOX-126A carriage insert the shock pad studs as shown in Fig. 7 (these are 1.25 in. long, standard 1/4 in. hollow set screws).

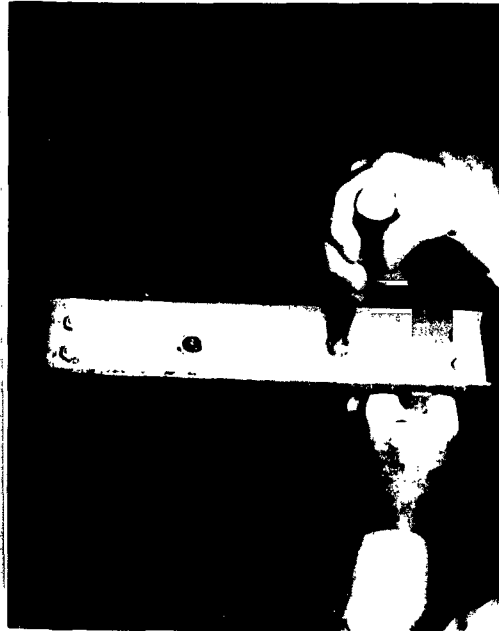


Fig. 6 Carriage Changeover

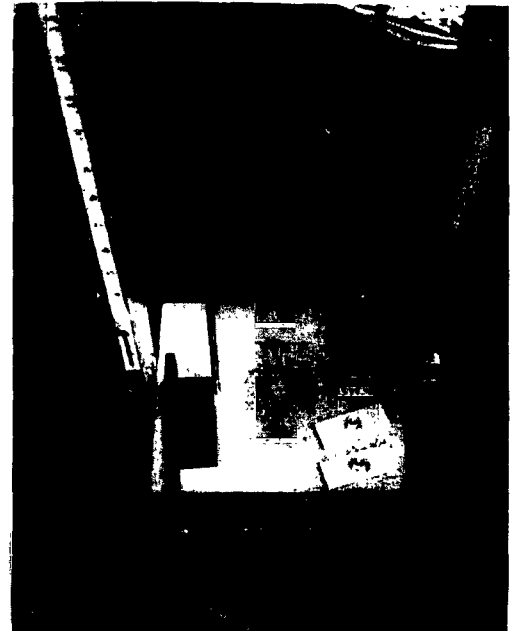


Fig. 7 Shock Pad Studs and Clamps

Place the desired impact pad over the projecting screws and secure the pads with the pad clamps — use the nut driver. When securing the pads, bring the clamps up tight. If the pads do not rest flat against the base, the pulses produced can be significantly changed.

ALWAYS KEEP A PAD IN PLACE ON THE BASE TO PREVENT  
DAMAGE TO THE STRIKING SURFACE OF THE CARRIAGE.

Having placed a pad on the base, set the new carriage on the pad. Insert the rods through the carriage sleeves and re-assemble the guide rods.

## OPERATING INSTRUCTIONS

14. Manual Operation: Operation of the drop tester consists simply of raising the carriage by hand to a desired drop height and suddenly releasing it. Catching the carriage after impact is equally simple since the carriage rebounds well over 50 percent of the drop height. The operator should make several dry run drops to familiarize himself with the "release-arrest" technique before testing components.



Fig. 8 Carriage Stop



Fig. 9 Strap Clamps

15. Mounting Components: To simplify the job of mounting components and changing shock pads a carriage stop, Fig. 8, has been provided to support the carriage about waist high. Fig. 8 also demonstrates the use of toe clamps for mounting flanged objects. Clamps are provided for flanges up to  $3/4$  in. thick. Lightweight straps and studs, Fig. 9, are provided for components up to 5 in. high. The studs and bolts furnished with the clamps are designed to be tightened with the fingers only to prevent stripping the threads in the carriage face or crushing delicate components.

DO NOT USE PLIERS AND BE SURE STRAP STUDS  
ARE ENGAGED AT LEAST FOUR THREADS BEFORE  
TAKING UP ON THE NUTS.

A hardened steel template duplicating the hole layout in the top of the carriage is furnished to facilitate drilling

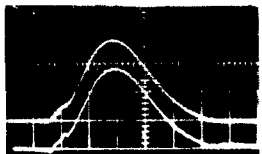
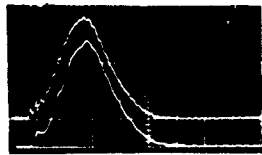
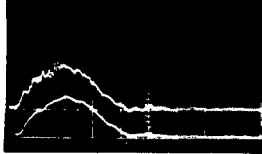
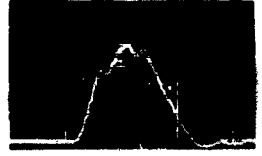
mounting holes in fixtures or components to be tested. Use toe clamp bolts to secure components wherever possible.

16. Drop-Height Scale: The drop-height scale must be adjusted to a new zero position when a pad is changed. To adjust the scale, let the carriage rest on the pad selected and loosen the set screws holding the scale about one-half turn. Raise or lower the scale until the end coincides with the pointer on the carriage. Tighten the clamp screws snug.

#### SELECTING SHOCK PADS

17. To simplify the job of selecting a pad for a particular shock pulse, Table 1 lists the significant shock parameters for each pad. Generally, the amplitude and duration

TABLE 1 - SHOCK PAD INDEX

Pad No.	Pulse Shape	Shock Range <sup>2</sup>	Shock Duration (t)	Form Factor (K) <sup>3</sup>
1		10 in. <sup>1</sup> - 58 g 70 in. - 174 g	12.0 ms 11.5 ms	0.51
2		10 in. - 145 g 70 in. - 530 g	5.75 ms 4.45 ms	0.47
3		10 in. - 405 g 70 in. - 1290g	1.50 ms 1.39 ms	0.57
4		10 in. - 840 g 70 in. - 3200g	0.86 ms 0.65 ms	0.52

<sup>1</sup>Drop height <sup>2</sup>For 1-lb test load <sup>3</sup>See paragraph 22

of a shock pulse are the specified parameters. The form factors listed above provide a quick method for determining average

accelerations and velocity changes (with  $\pm 5$  percent accuracy) for the shock amplitudes and durations specified. These are the significant parameters in inertia sensitivity testing.

#### INSTRUMENTATION

18. Trigger: It may be necessary for some tests to monitor the shock or the operation of a device being tested. For this purpose the test set is equipped with a special trigger, Fig. 10 (right column). The device is a normally-closed, shock-resistant switch designed to be actuated by the carriage just before carriage impact. The carriage contact is a flexible beryllium copper strip which can deflect as much as 3 in. without permanent set. The unit may be adjusted up and down on the right column to trigger recording instruments as close as 50 microseconds before carriage impact.



19. Accelerometers: The test set was calibrated with an undamped 15,000 cps, 10,000 g crystal accelerometer backed up with a 0.3 critically damped, unbonded strain gage, 3000 cps, 5000 g accelerometer. The recording equipment had a flat frequency response of 10,000 cps or greater.

20. To calibrate the Mk 209 Mod 0 carriage (Appendix A) it was necessary to filter the pulses generated by spring A to determine the fundamental acceleration-time signature (see paragraph A-2).

#### CALIBRATION CURVES\*

21. Calibration curves, Fig. 11 through 14, giving shock amplitude and duration are furnished. Each pad was calibrated for payloads of 1 lb, 2 1/2 lb, and 4 lb. Drops were made at 10 in., 20 in., 35 in., 50 in., and 65 in. for each curve shown. It should not be necessary to monitor the shock for standard laboratory tests or for screening components in production. Interpolating for test loads between those presented

\*To be used with the NOL Test Set only. No data are available on shock parameter agreement from machine to machine

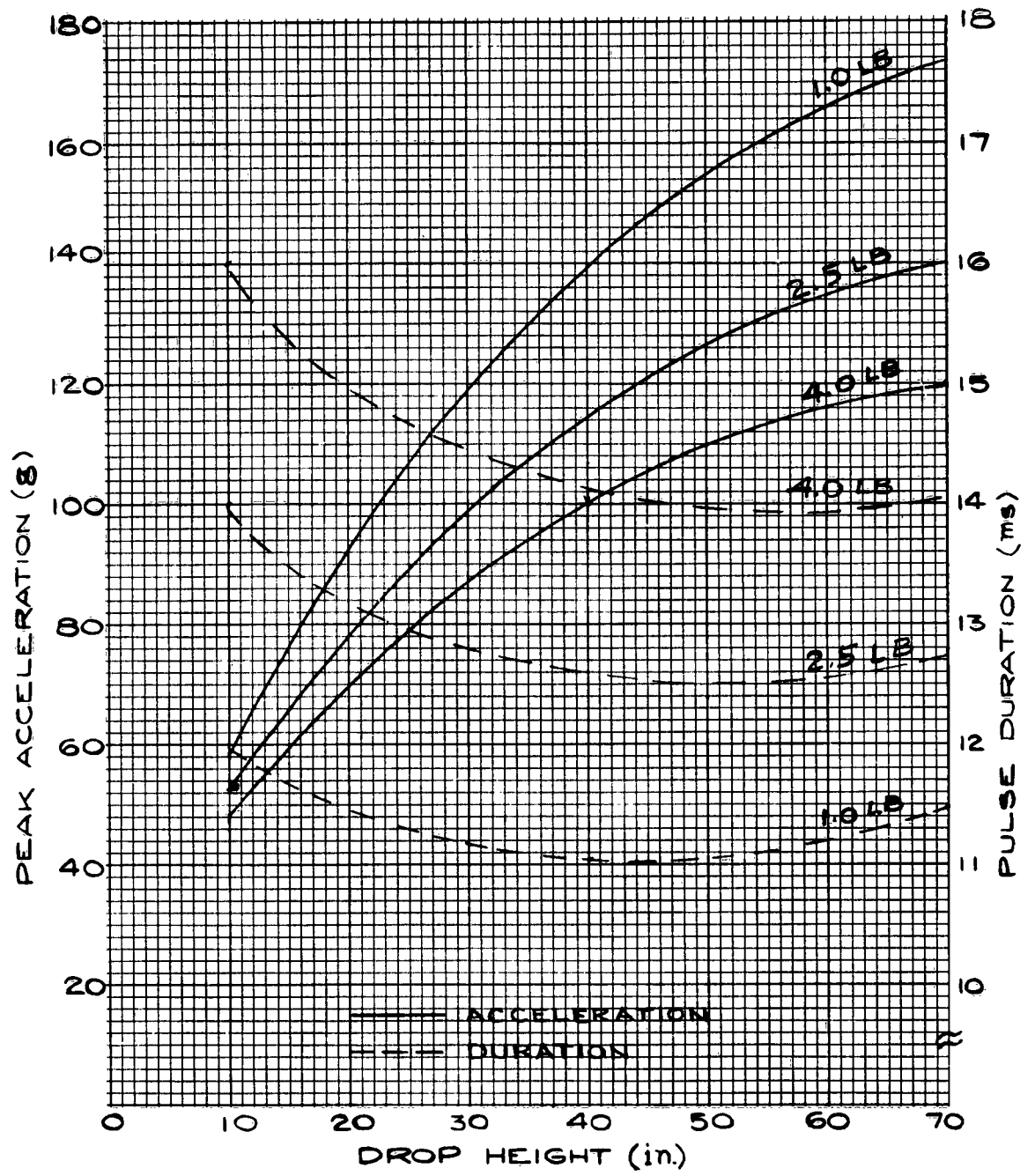


Fig. 11 Pad No. 1 Calibration Curve

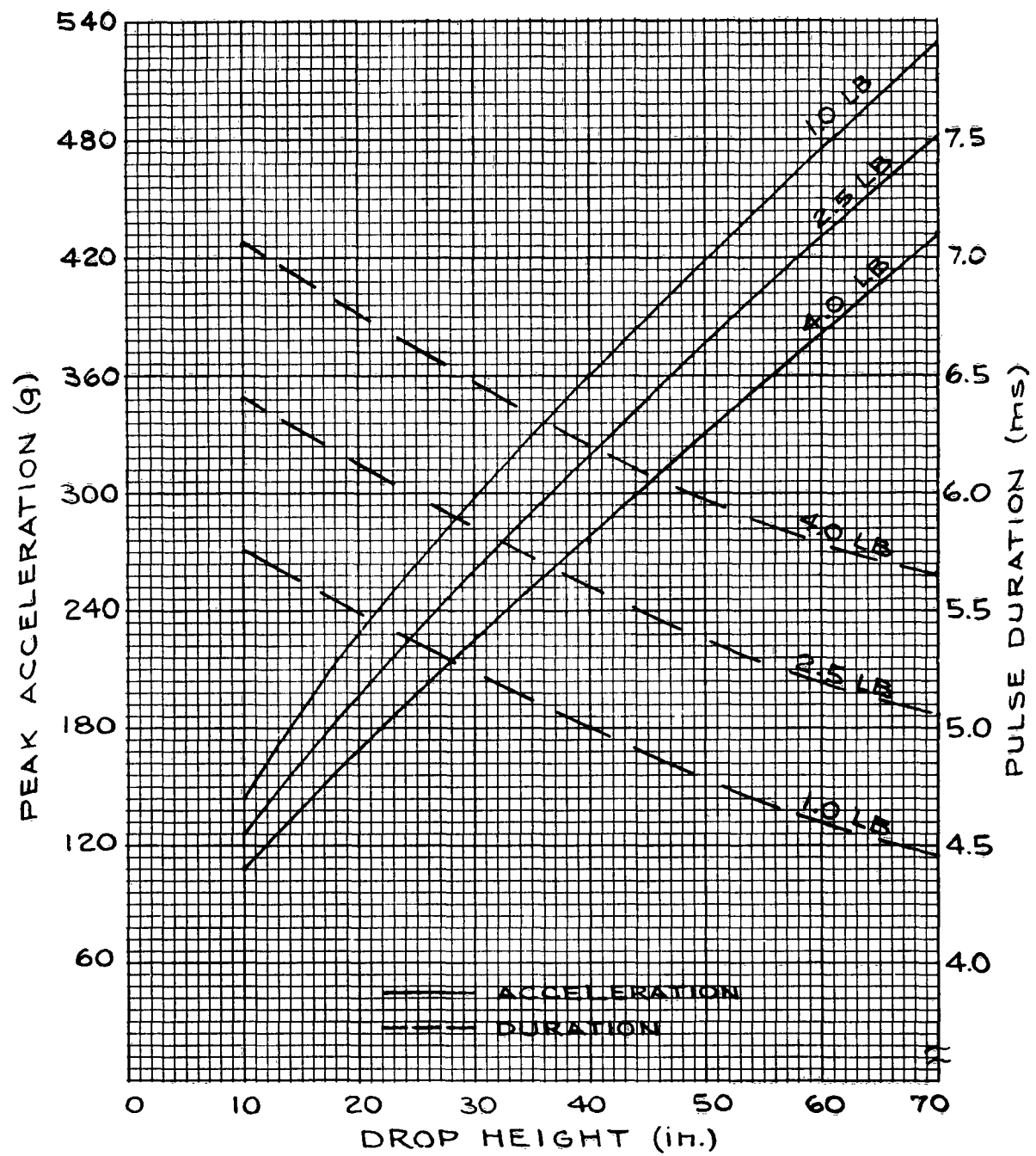


Fig. 12 Pad No. 2 Calibration Curve



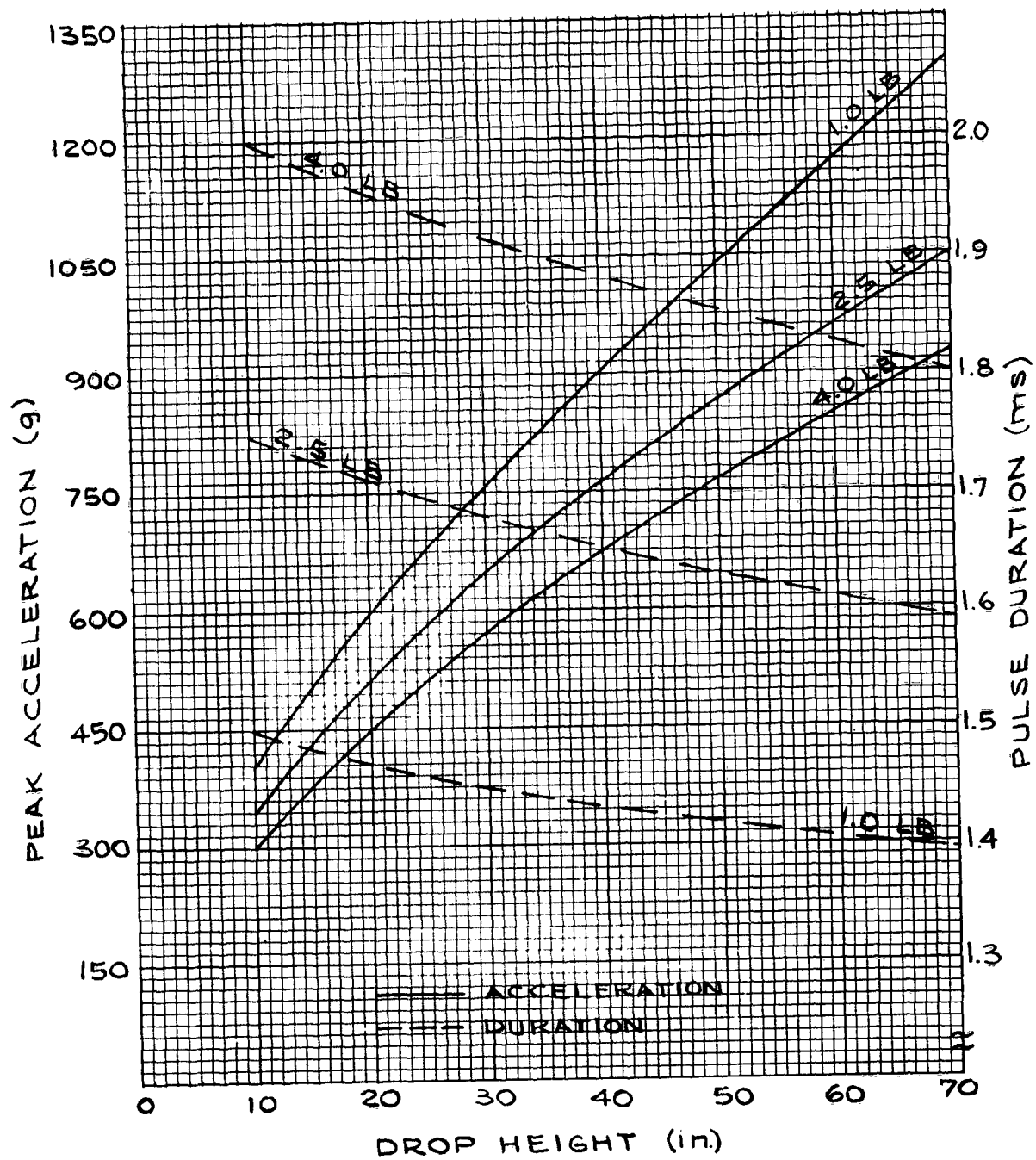


Fig. 13 Pad No. 3 Calibration Curve

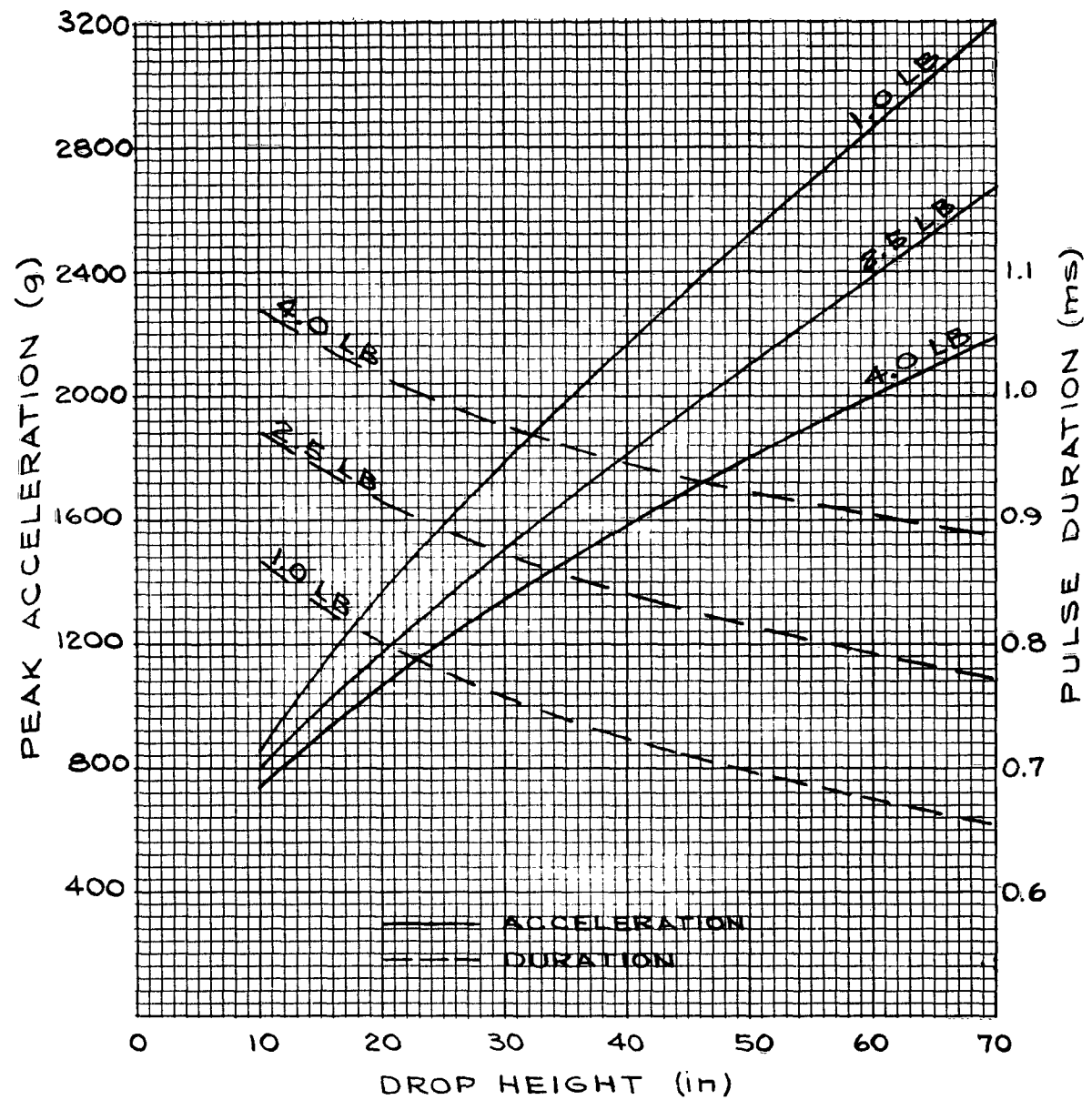


Fig. 14 Pad No. 4 Calibration Curve

in the calibration curves should give acceptable accuracy ( $\pm 5$  percent) for most applications; however, dummy weights should be added to bring test loads up to curve values where greater accuracy is required.

22. To determine average acceleration or velocity change from the shock parameters given in the calibration curves, use the form factors (K) given in Table 1. For example, the average acceleration for a pad No. 4 shock pulse of 2000 g is

$$A_{\text{average}} = K A_{\text{peak}}$$

$$K = 0.52$$

$$A_{\text{av}} = 0.52 \times 2000 = 1040 \text{ g}$$

Similarly, the velocity change for a 2000 g pulse of 0.74 ms duration is

$$\Delta V = K A_{\text{pk}} g t = 0.52 \times 2000 \times 32.2 \times 0.74 \times 10^{-3} = 24.8 \text{ fps}$$

#### MAINTENANCE

23. After about 50 drops, shock pad screws and guide rods should be checked for tightness. After several hundred drops the same check should be made on all bolts and screws.

24. Over a two or three year period, rubber will harden slightly. The soft pads should be checked for durometer hardness at four or five points against that stenciled on the pad. If the durometer hardness changes more than three points, the pads should be replaced. The tester should be recalibrated.

25. When moving or shipping the drop tester lower the carriage so it rests on the shock pad, and wrap tape around the guide rods just above both carriage sleeves to prevent the carriage from sliding. Tape the carriage stop to the right column. Stow the nut driver in the parts kit and fill the kit with packing material to prevent the mounting hardware from getting scrambled during shipping. If the tester is crated, "this side up" should be appropriately marked on the crate.

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**REFERENCES**

- (a) MIL-STD-202B, Test Methods for Electronic and Electrical Component Parts**
- (b) NAVWEPS OD 20944, Test Set Mk 209 Mod 0**
- (c) NAVORD REPORT 5779, Gravity-Sensitive Component Shock Tester**
- (d) BUORD LD-275962, Test Set Mk 209 Mod 0, Parts List and Drawings**
- (e) NAVORD REPORT 6925, NOL Copper-Ball Accelerometers**

# APPENDIX A CHARACTERISTICS OF TEST SET MK 209 MOD 0

A-1. The test set Mk 209 Mod 0 was initially designed to perform tests at shock levels an order of magnitude higher than the maximum shock range of the MIL-STD-202B (Method 202A shock) tester, reference (a). Recently, however, the original 5K lb. per in. spring was incorporated in the Mk 209 design to extend its use to MIL-STD-202B testing — the two springs are now used interchangeably.

A-2. Shock oscillograms are presented in Fig. A-1 for comparison of the shock characteristics of the Mod 0 and 126A testers. The fundamental pulse produced by spring A is fairly repeatable; however, the character of the pulse produced by spring B is such that the amplitude and duration of the significant oscillations vary widely from drop to drop.

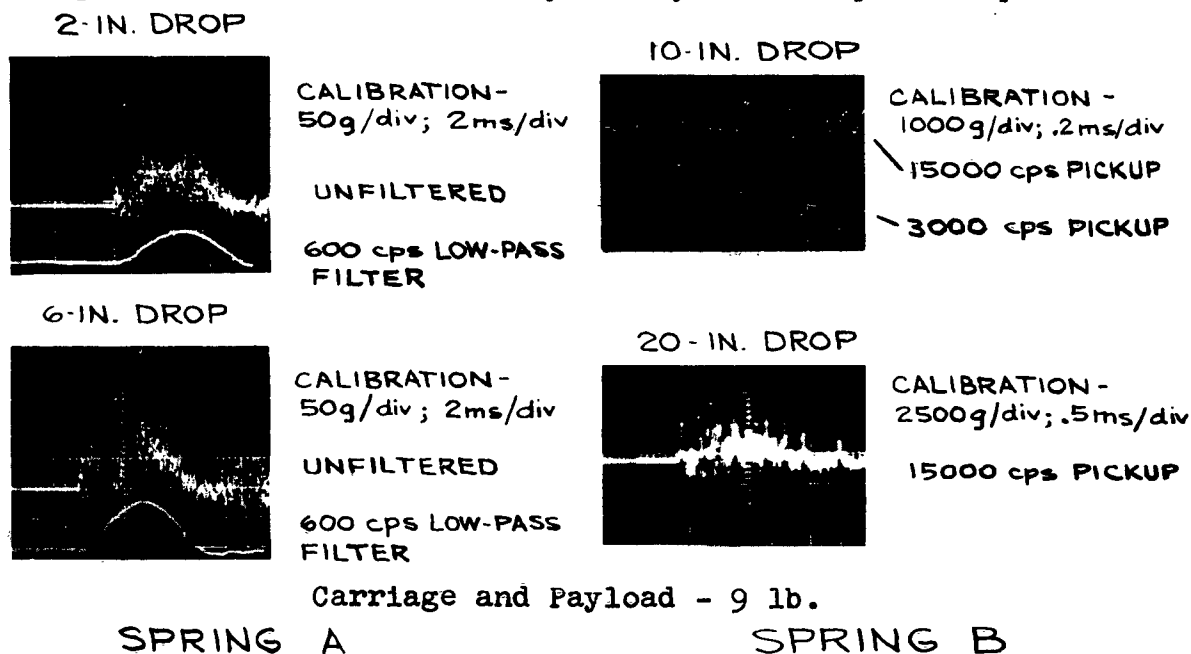


Fig. A-1 Oscillograms of Mk 209 Mod 0 Pulses

A-3. For convenience, calibration curves, Fig. A-2 and A-3, for the test set Mk 209 Mod 0 are presented. The calibration for the heavy spring was made with Mk 1 Mod 0 Copper-Ball Accelerometer as specified in reference (b) for spring B. The calibration for the light spring (spring A) was made using the continuous recording equipment described in paragraph 19. The accuracy of the values given is  $\pm 10$  percent. See reference (e) for use of copper-ball accelerometer as velocity meter.

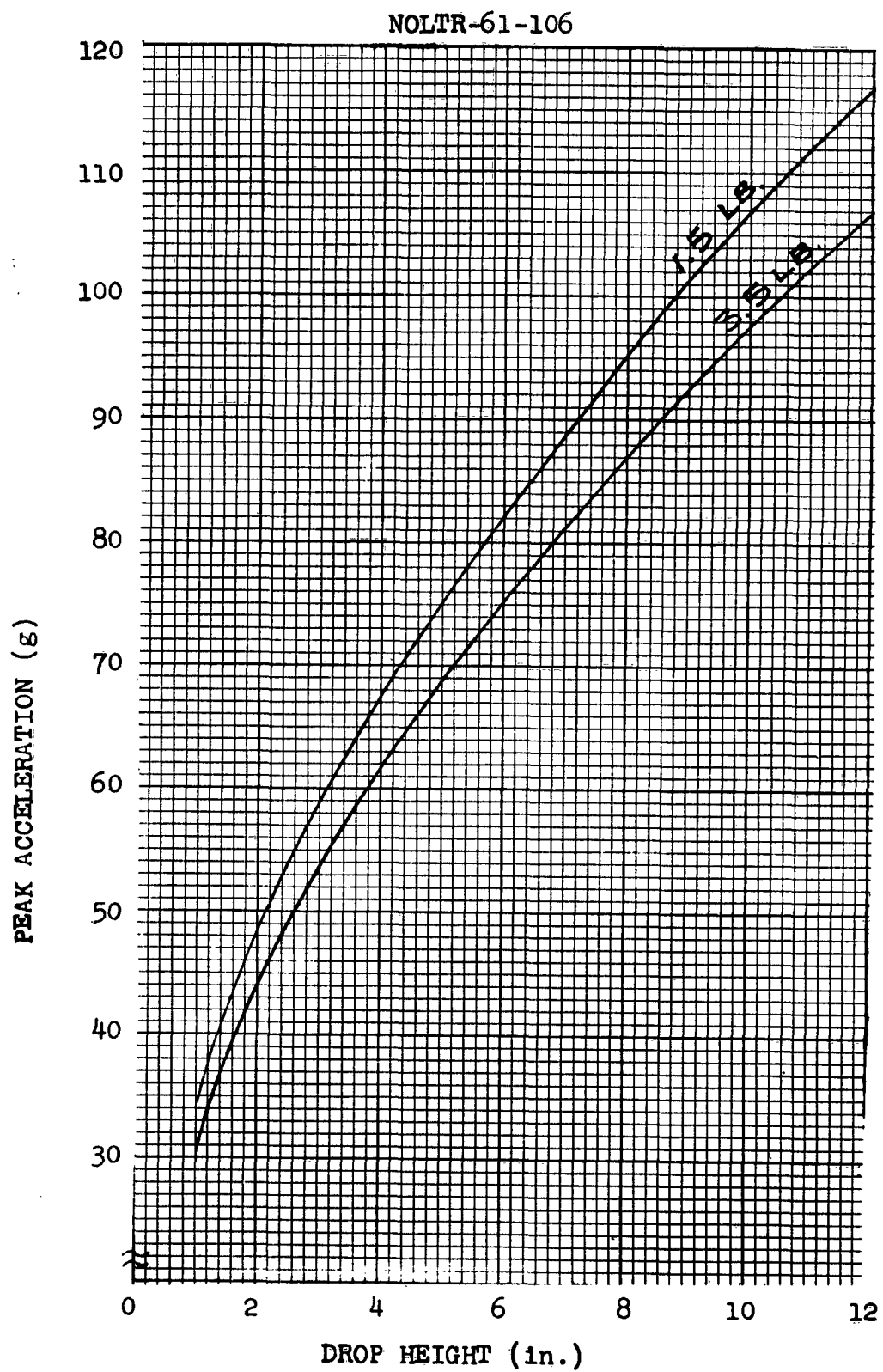


Fig. A-2 Test Set Mk 209 Mod 0 Calibration Curve  
(Spring A)

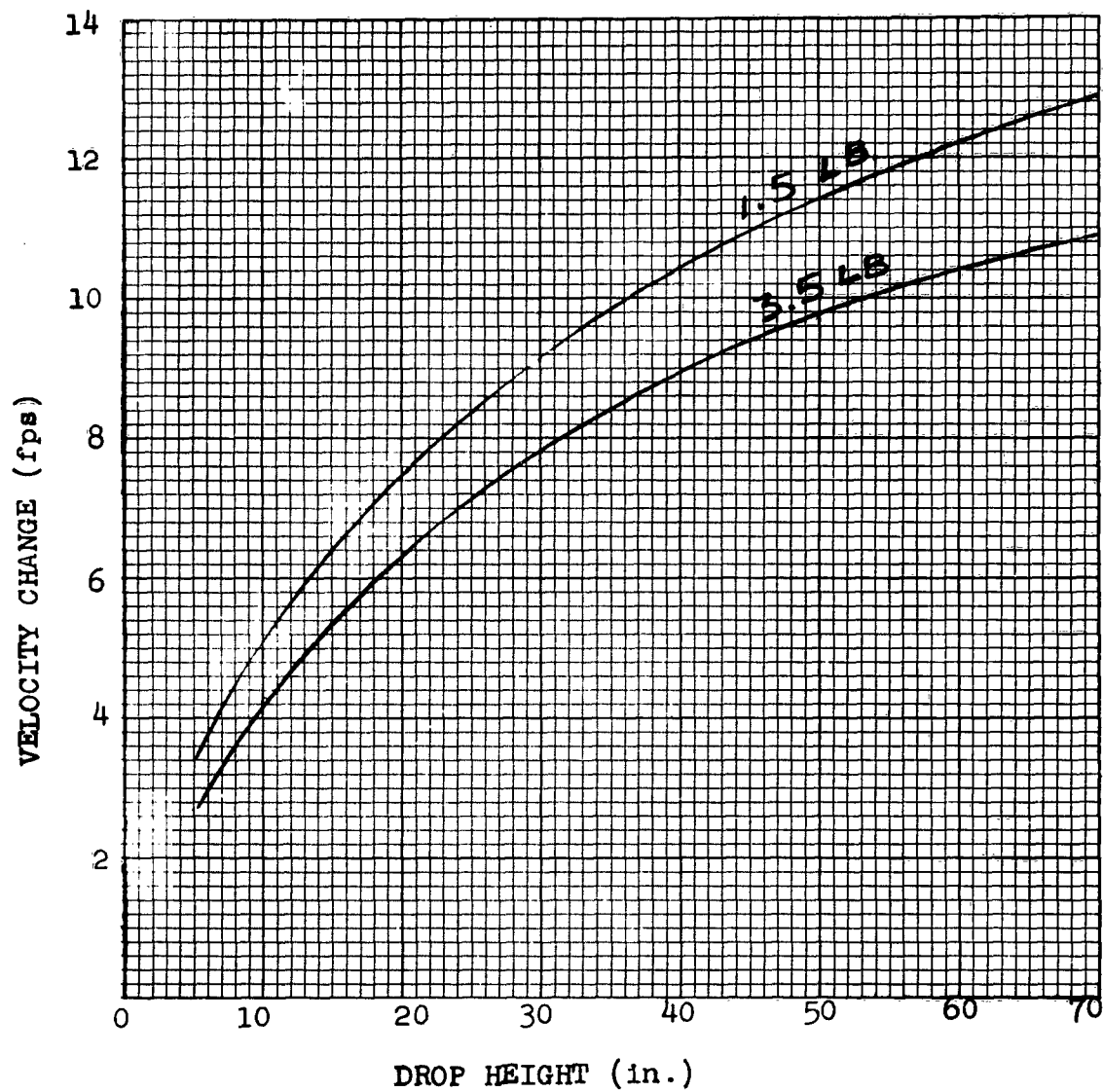


Fig. A-3. Test Set Mk 209 Mod 0 Calibration Curve  
(Spring B)

## APPENDIX B

## TEST SET DRAWINGS AND COST OF PARTS

Drawings

B-1. Drawings and parts for the WOX-126A Test Set are listed in BuWeps LD 515960. (The drawings are not authenticated and are submitted herein for reference only.) The drawings are for a complete WOX-126A Tester and are not intended to provide parts for the Mk 209. Parts necessary to conduct Mk 209 Mod 0 tests are the Mk 209 Test Carriage and Anvil. Drawings for these may be found in reference (d), see paragraph 12 of this report for installation instructions.

Cost of Parts

B-2. Until they are phased out and discontinued for ordnance use, Mk 209 Mod 0 Testers will be available to government and defense agencies, see paragraph 9. It is recommended, therefore, that wherever possible existing Mk 209's be utilized for WOX -126A applications. Costs are given for the parts which convert the Mk 209 to a WOX-126A Tester - costs are for one-unit production. Since the NOL prototype was made up from an existing Mk 209 Tester, no figures are available on a complete WOX-126A Test Set.

Essential WOX-126A Parts:

Test Carriage-----	\$200
Shock Pads-----	150
Drop-height Scale-----	10

Total \$360

Optional Parts:

Carriage Stop-----	\$ 15
Trigger-----	80
Pad Clamps-----	75
Parts Kit-----	50
Mounting Hardware (clamps, etc.)-----	250
Hole Template-----	40
Nut Driver-----	5

Total \$515



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NOLTR 61-106

DEPARTMENT OF THE NAVY <b>BUREAU OF NAVAL WEAPONS</b> WASHINGTON 25, D.C.		CODE IDENT. 10001	BOWEPS LD NO. 515960 SHEET 2
SUBJECT: <b>TEST SET, DROP SHOCK, WOX-126A</b> (For reference only)			
LIST OF DRAWINGS, ASSEMBLIES, PARTS, SPECIFICATIONS ETC.			

COL NO. 1	2	3	4	5	6	7	8	9	10	11	12
DWG. NO., LD NO. OR OTHER IDENTIFICATION	NO. REQUIRED FOR ONE "NEXT ASSEMBLY"						TOTAL ITEMS OR QUANTITY	NOMENCLATURE	(*) FIND NO.	REMARKS	DRW. NO.
2283642	1						1	DROP-HEIGHT SCALE			1
2283356	2						2	SCALE CLAMP & SCREW			2
											3
2283355	1						-	PARTS KIT			4
2290322	1						1	SHOCK PAD #1			5
2290323	2						2	SHOCK PAD #2			6
2290324	1						1	SHOCK PAD #3			7
2290325	1						1	SHOCK PAD #4			8
2290326	2						2	SHOCK PAD HOLDER			9
2284021	12						12	TOE CLAMPS			10
2284022	12						12	TOE CLAMP BOLTS			11
2284023	4						4	LONG STRAP CLAMP			12
2284024	4						4	SHORT STRAP CLAMP			13
2284025	12						12	STRAP CLAMP STUD & NUTS			14
											15
2293659	1						1	DOLLEY			16
2293660	1						1	DOLLEY FRAME			17
											18
											19
											20
											21
								MISC. CONNECTING PARTS			22
											23
											24
MS-51017-69	2						2	SCREW SET SOC HD. STL. 1/4-20NC-2 X 7/8 LG.			25
											26
MS-35204-12	1						1	PAN HD CAP SCREW #4-40NC-2 X 1/4 LG.			27
											28
FF-C-82	3						3	2" RUBBER CASTER			29
								TYPE I, CLASS I			30
								SIZE B			31
											32
											33
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 LD NO. 515960  
 SHEET NO. 2

NOLTR 61-106

DEPARTMENT OF THE NAVY <b>BUREAU OF NAVAL WEAPONS</b> WASHINGTON 25, D.C.		CODE IDENT. 10001	BOWEPS LD NO. <b>515960</b> SHEET 3
SUBJECT: <b>TEST SET, DROP SHOCK, WOX-126A</b> (For reference only)			

COL NO. 1	2	3	4	5	6	7	8	9	10	11	12
DWG. NO., LD NO. OR OTHER IDENTIFICATION	NO. REQUIRED FOR ONE "NEXT ASSEMBLY"						TOTAL ITEMS OR QUANTITY	NOMENCLATURE	(*) PIND NO.	REMARKS	DRG. NO.
											1
											2
MS-35237-83	2						2	SCREW, FLAT HD, CAP, 1/4-20 NC-2 X 1/4 LG.			3
											4
MS-35289-6	20						20	SCREW CAP HEX. HD 1/4-20 NC-2 X 3/4 LG.			5
											6
MS-35690-401	14						14	NUT HEX REGULAR SEMI-FINISHED STEEL, 1/4-20 NC-2			7
											8
											9
											10
MS-35339-6	30						30	WASHER SPRING, STEEL, 1/4			11
											12
43-N-2700-535	2						2	NUT, HEX CAP SEMI-FINISHED STL ZINC PLATED 1/4-20 NC-2			13
											14
											15
											16
											17
											18
											19
MIL-E-15599 (ZIFES)							AS FOUN.	BULK MATERIALS			20
MIL-P-15130								WELDING MATERIAL			21
MIL-P-6889 TYPE I								PAINT, HAZE GRAY			22
MIL-C-5092								PRIMER ZINC CHROMATE			23
MIL-C-6052								CEMENT ADHESIVE			24
MS-35501								CEMENT RUBBER			25
MIL-E-16663								PAINT, GLASS BLACK			26
											27
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FORM C-800L-111/10 (10-40)

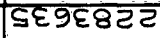
LD NO. 515960  
SHEET NO. 3

DEPARTMENT OF THE NAVY BUREAU OF ORDNANCE WASHINGTON, D. C.		L.D. NO. 515960 SHEET 4 UNCL SECURITY INFORMATION
SUBJECT: TEST SET, DROP SHOCK, WOX-126A (For reference only) LIST OF DRAWINGS, ASSEMBLIES, PARTS, SPECIFICATIONS, ETC.		
SUMMARY OF DRAWINGS, LISTS OF DRAWINGS, STANDARDS, SPECIFICATIONS, AND PUBLICATIONS FOR ONE SUBJECT ITEM		LINE NO.
DRAWINGS		1
BUORD DWGS. 2283354; 2283355; 2283356;		2
2283635; 2283636; 2283637;		3
2283642; 2283643; 2283644;		4
2283645; 2283646; 2283647; 2283654; 2283655;		5
2284021; 2284022; 2284023; 2284024; 2284025; 2284254;		6
2284255; 2284256; 2284259.		7
2284260; 2287856; 2289509; 2290322; 2290323		8
2290324; 2290325; 2290326.		9
STANDARDS AND SPECIFICATIONS		11
FURNISHED BY CTDO, NOP, LOUISVILLE 14, KY.		12
NAVORD CSTDs. 2; 52		13
PAGES FROM NAVORD OSTD 600 FOR: 43-N-2700-535		14
FURNISHED BY NAVAL AVIATION SUPPLY DEPOT, PHILADELPHIA 11, PA.		15
FEDERAL STANDARDS		16
MIL AND JAN STANDARDS MIL-STD-8; MIL-STD-10; MIL-STD-12		17
MILITARY STANDARD (MS) SHEETS: MS-35204-12		18
MS-35204-66; MS-35501		19
MS 35339-6; MS 51017-69; MS 35511; MS 35621-41		20
FEDERAL SPECIFICATIONS: QQ-S-652		21
MIL SPECIFICATIONS MIL-C-5092; MIL-C-6052		22
MIL-H-1209; MIL-N-18352; MIL-P-15035		23
MIL-R-3065; MIL-W-7986		24
PROCURE FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT		25
PRINTING OFFICE, WASHINGTON 25, DC.		26
NBS HANDBOOK H-28		27
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L.D. NO. 515960  
SHEET NO. 4

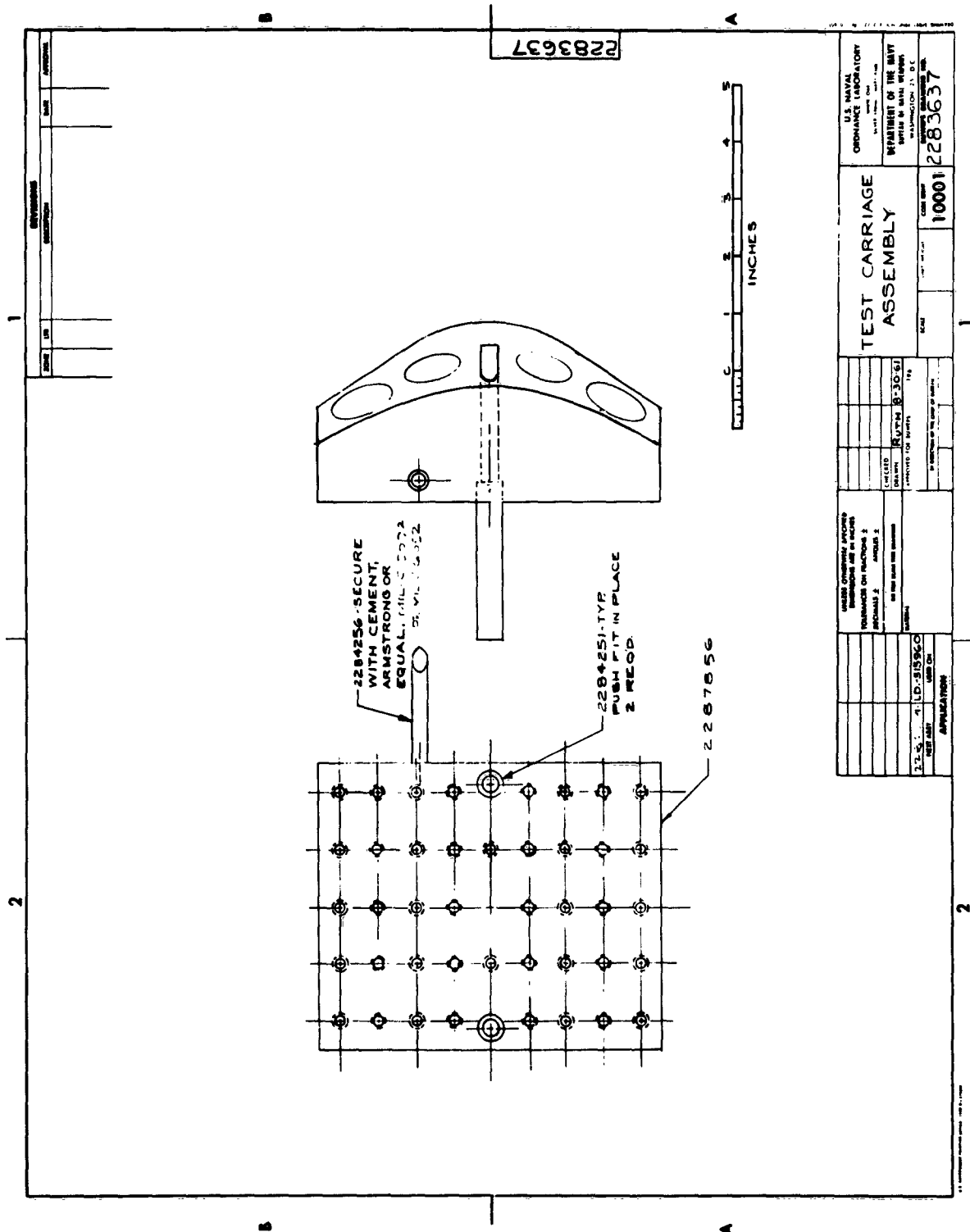


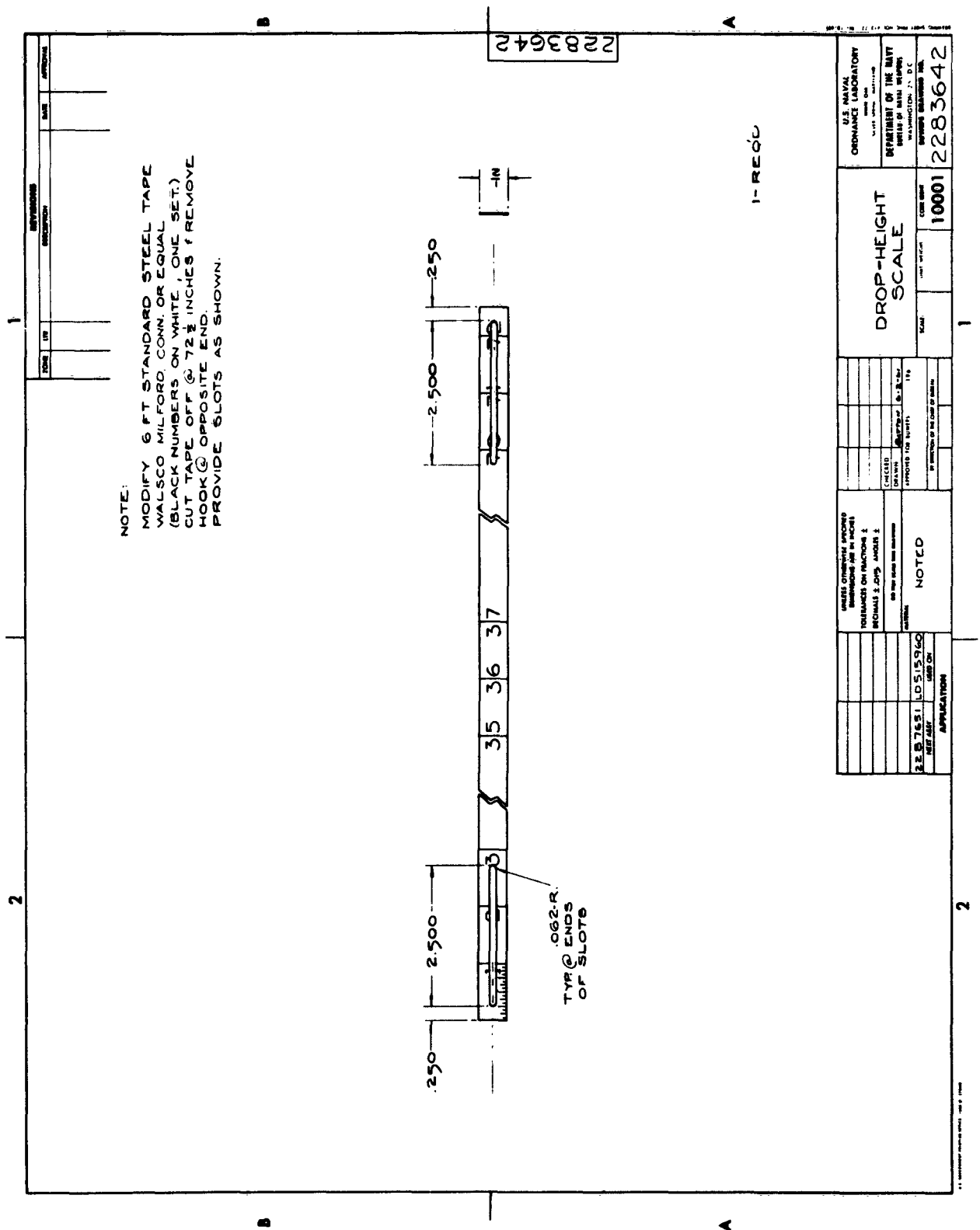


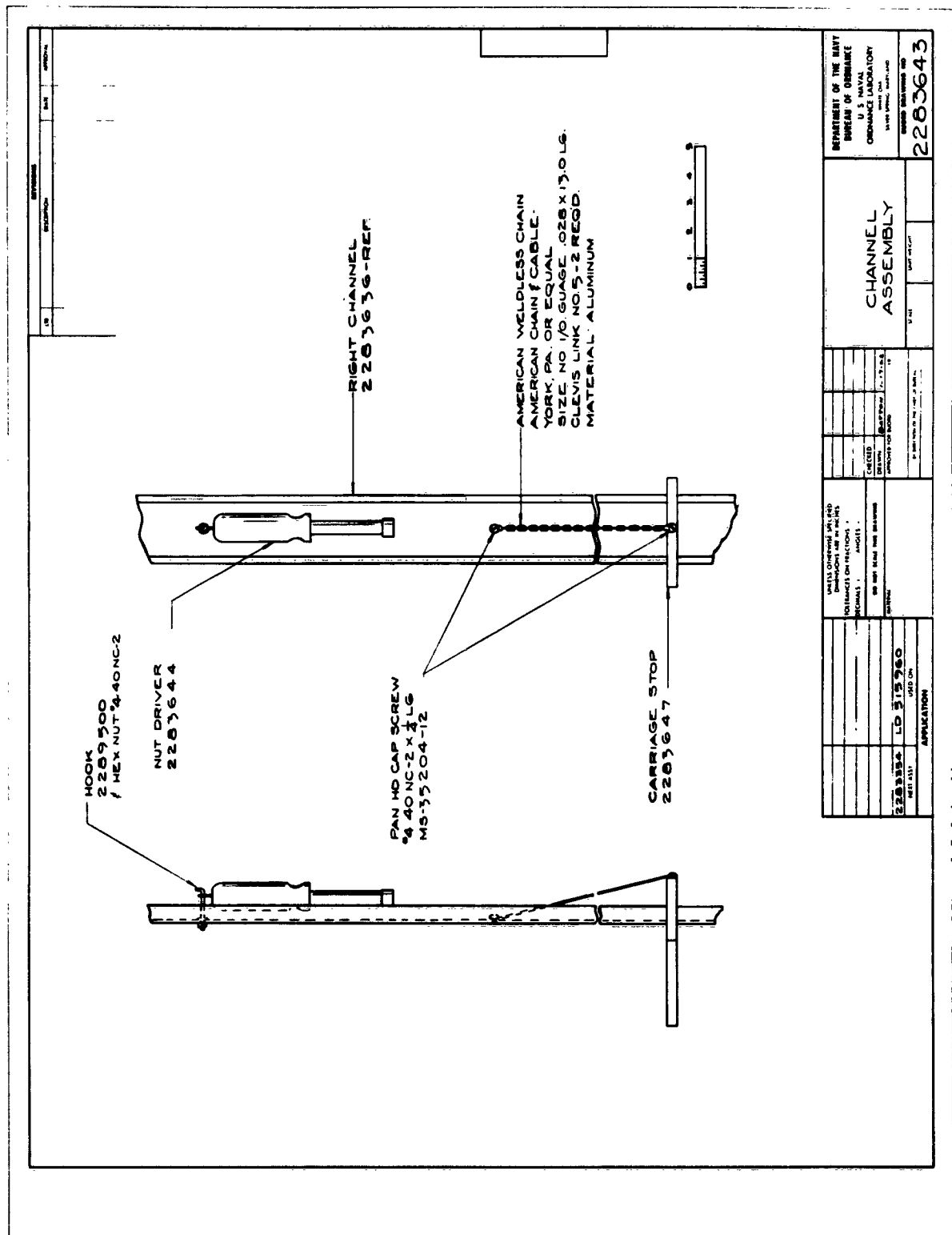


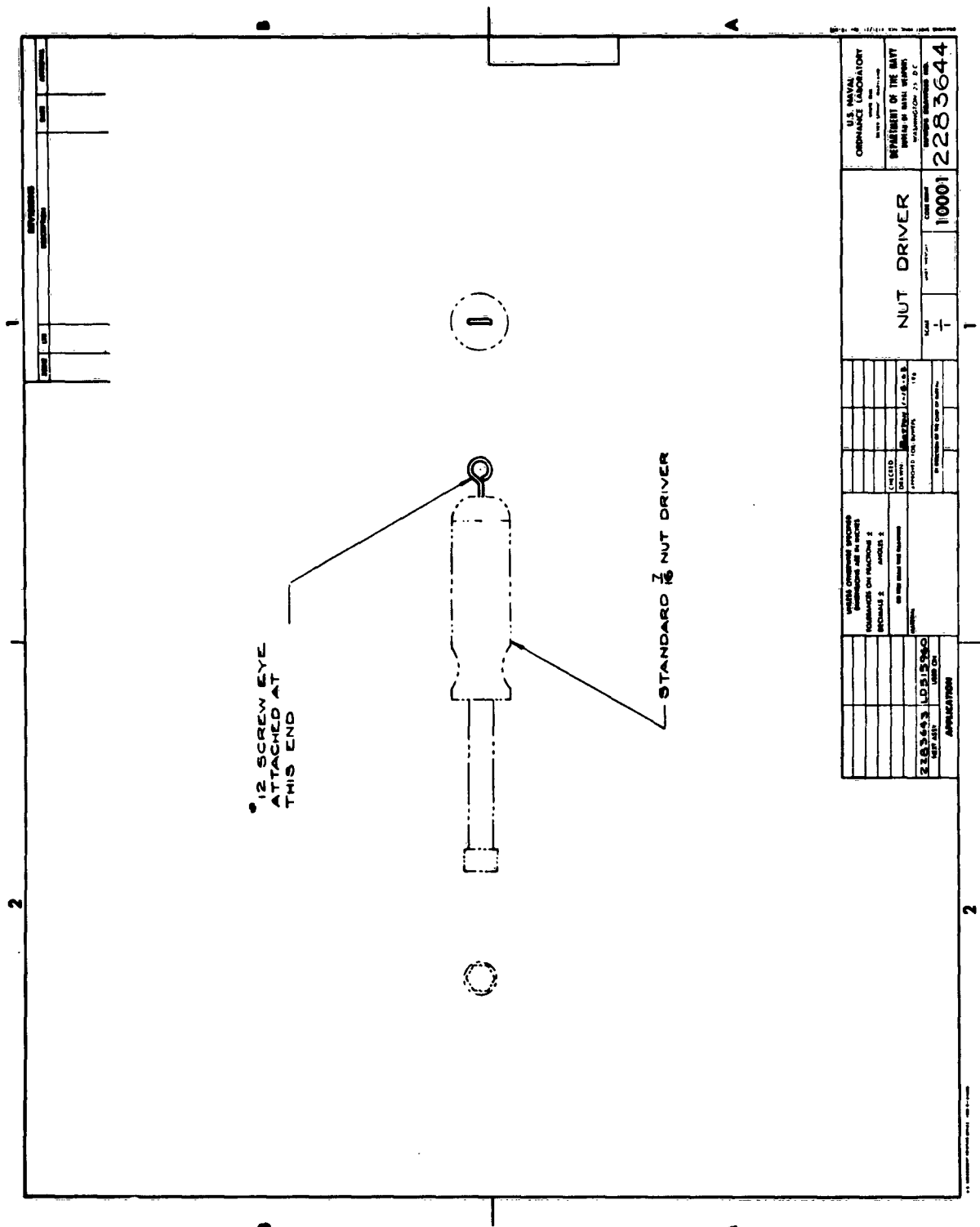


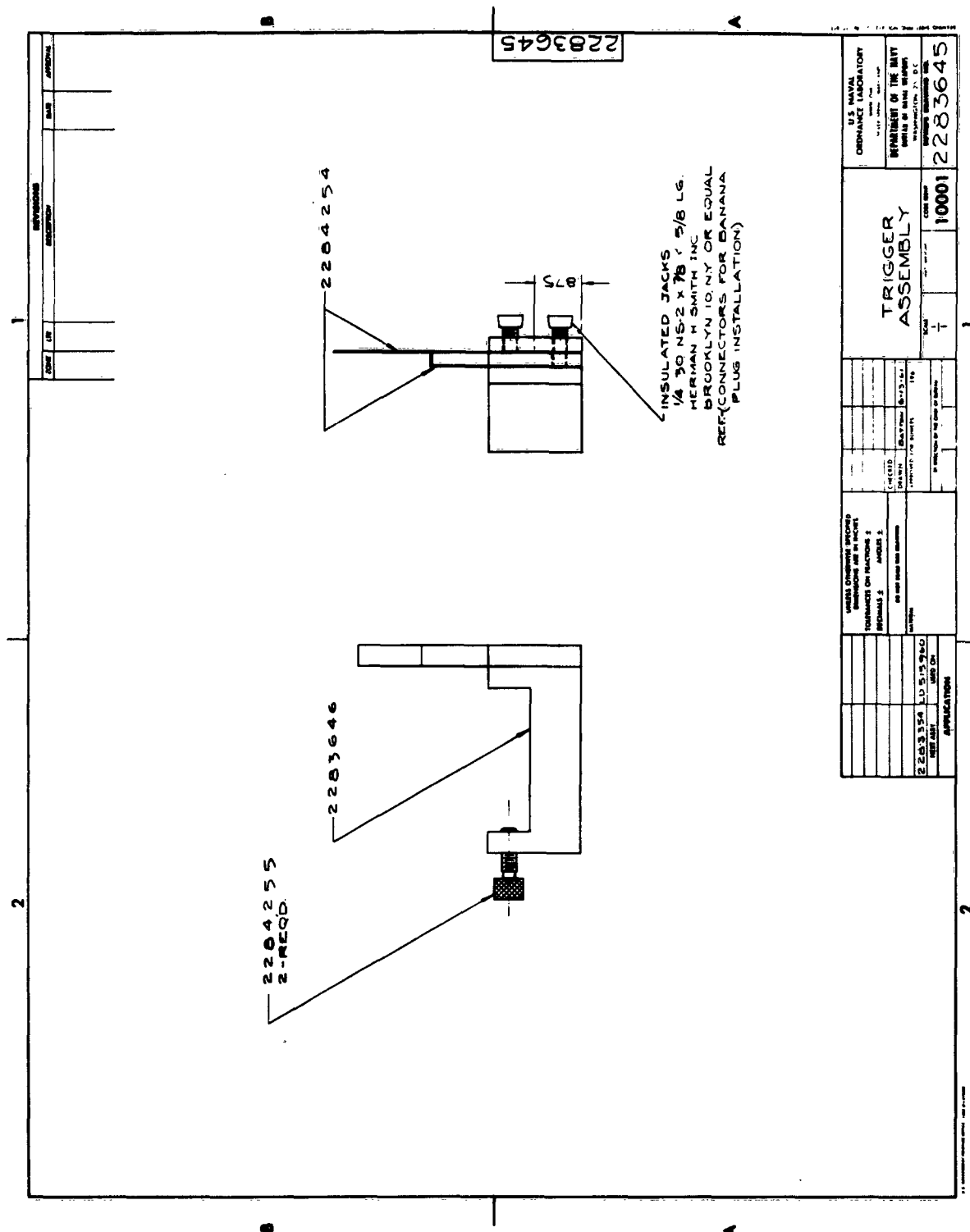




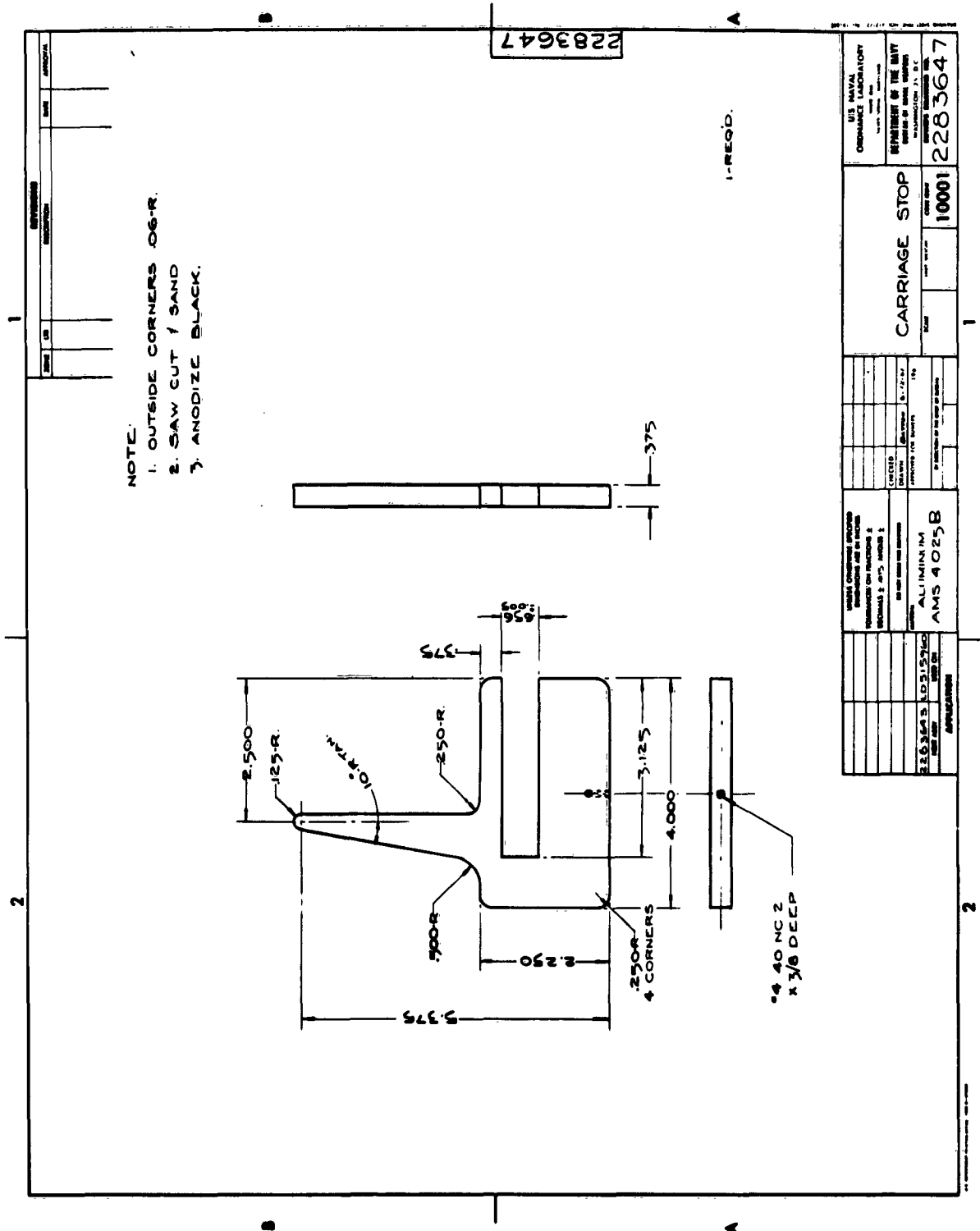


















2283655



2284021

**NOTE.**  
 1. SHARP CORNERS .015-R.  
 2.  $\frac{1}{32}$  FINISH ALL OVER.  
 3. ANODIZE BLACK  
 4. PIECES MATCH TOE CLAMP  
 BOLTS DWG. 2284022  
 AS NUMBERED

REVISIONS		
SYM	DESCRIPTION	DATE

PIECE	DIMENSION	NO. REQ'D
1	L = 3/4	4
2	L = 1/2	4
3	L = 1/4	4

2287651 NEXT ASSY APPLICATION	LD-515960 USED ON	TOE CLAMPS
	U.S. NAVAL ORDNANCE LABORATORY SILVER SPRING MARYLAND	

APPROVED BY INSPECTION OF THE CLIP IN BUREAU	10	U.S. NAVAL ORDNANCE LABORATORY DEPARTMENT OF THE NAVY U.S. NAVAL ORDNANCE LABORATORY SILVER SPRING MARYLAND
CHECKED DRAWN	5-12-61	BUORD DRAWING NO 2284021

DRAWING SHEET PREC. NOL. 5311 B REV. (1-53)

1. LASTEST PREC. NOL. 5311 B REV. (1-53)

2284022

**NOTE:**

1. ANODIZE BLACK.
2. ASSEMBLE BOLTS & TOE CLAMPS DWG. 2284021 AS SHOWN. USE STD STEEL NUT.

PIECE	DIMENSION	NO. REQD.
1	L = 1.0	4
2	L = 3/4	4
3	L = 5/8	4

REVISIONS		
SYM	DESCRIPTION	DATE

<p style="font-size: 24px; font-weight: bold;">TOE CLAMP BOLTS</p>		<p>U. S. NAVAL ORDNANCE LABORATORY SILVER SPRING, MARYLAND</p>	
		<p>BUORD DRAWING NO. 2284022</p>	
<p>APPROVED</p>		<p>BY SECTION OF THE CHIEF OF BUREAU</p>	
<p>UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. FRACTIONS ARE TO BE SHOWN AS DECIMALS. TOLERANCES ON FRACTIONS: 1/64, 1/32, 1/16, 1/8, 1/4, 1/2, 3/4, 1, 1 1/2, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100.</p>		<p>DO NOT SCALE THIS DRAWING</p>	
<p>MATERIAL: ALUMINUM MIL-W-7986(1), COMP 1100</p>		<p>DEFINITIONS OF LINES: 1100</p>	
<p>2287651 LD-515960</p>		<p>USED ON</p>	
<p>APPLICATION</p>		<p>SCALE: 1" = 1/2"</p>	

<div style="border: 1px solid black; padding: 5px; display: inline-block;">2284023</div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;">2284023</div>	
<p><b>NOTE</b></p> <ol style="list-style-type: none"> <li>1. SHARP CORNERS .02-R</li> <li>2. 125/ ALL OVER</li> <li>3. ANODIZE BLACK</li> </ol>		<p><b>4-REQD.</b></p>	
		<p><b>LONG STRAP CLAMP</b></p>	
<p><b>2287651</b></p>		<p><b>2284023</b></p>	
<p><b>LD-315960</b></p>		<p><b>UNIT WT</b></p>	
<p><b>USED ON</b></p>		<p><b>SCALE</b></p>	
<p><b>APPLICATION</b></p>		<p><b>FOR ORDER</b></p>	
<p><b>UNLESS OTHERWISE SPECIFIED</b></p>		<p><b>APPROVED</b></p>	
<p><b>ALL DIMENSIONS ARE IN INCHES</b></p>		<p><b>18</b></p>	
<p><b>DO NOT SCALE THIS DRAWING</b></p>		<p><b>ST DIRECTION OF THE GILD OF REBAR</b></p>	
<p><b>MATERIAL</b></p>		<p><b>CHECKED</b></p>	
<p><b>ALUMINUM</b></p>		<p><b>DRAWN</b></p>	
<p><b>AMS-4102 A</b></p>		<p><b>DATE</b></p>	
<p><b>SPECIFICATIONS OF LATEST ISSUE APPLY</b></p>		<p><b>DATE</b></p>	
<p><b>2287651</b></p>		<p><b>2284023</b></p>	
<p><b>LD-315960</b></p>		<p><b>UNIT WT</b></p>	
<p><b>USED ON</b></p>		<p><b>SCALE</b></p>	
<p><b>APPLICATION</b></p>		<p><b>FOR ORDER</b></p>	
<p><b>UNLESS OTHERWISE SPECIFIED</b></p>		<p><b>APPROVED</b></p>	
<p><b>ALL DIMENSIONS ARE IN INCHES</b></p>		<p><b>18</b></p>	
<p><b>DO NOT SCALE THIS DRAWING</b></p>		<p><b>ST DIRECTION OF THE GILD OF REBAR</b></p>	
<p><b>MATERIAL</b></p>		<p><b>CHECKED</b></p>	
<p><b>ALUMINUM</b></p>		<p><b>DRAWN</b></p>	
<p><b>AMS-4102 A</b></p>		<p><b>DATE</b></p>	
<p><b>SPECIFICATIONS OF LATEST ISSUE APPLY</b></p>		<p><b>DATE</b></p>	

DRAWING SHEET PRINC NOL-3381 B REV. (1-53)

DRAWING SHEET PNC-NOL-5361 H KEV. (1-53)

[illegible]



2284251

NOTE: <sup>24</sup>✓ ALL OVER, EXCEPT AS NOTED, (MIL-STD-10)

2 REQ'D.

REVISIONS	
SYN	DATE

UNLESS OTHERWISE SPECIFIED  
REMOVE BURRS AND SHARP EDGES  
DIMENSIONS ARE IN INCHES  
FRACTIONS - 16THS  
DECIMALS - .010 ANGLE 1:2

DO NOT SCALE THIS DRAWING

MATERIAL: NYLON  
PLASTIC

2283637 LD-515960  
NEXT ASSY USED ON

APPLICATION

APPROVED

BY DIRECTION OF THE CHIEF OF BUREAU

CHECKED

DRAWN

RUTH 5-23-64

CARRIAGE GUIDE

SCALE

UNIT WT

JOB ORDER

BUREAU OF ORDNANCE  
DEPARTMENT OF THE NAVY  
U. S.  
NAVAL ORDNANCE LABORATORY  
WHITE OAK  
SILVER SPRING  
BARTLAND

BUOY DRAWING NO  
2284251

[illegible]

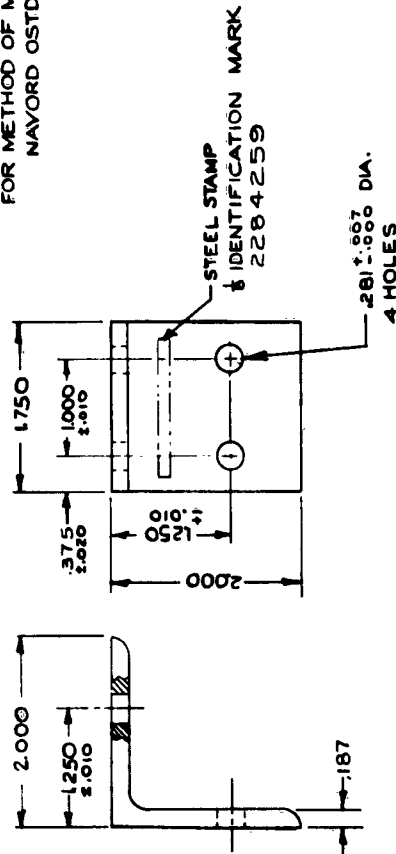
DATE RECEIVED: 11/11/2011 10:11:11 AM

**Abstract**

REVISIONS		
SYM	DESCRIPTION	DATE

2284259

NOTE:-  
SPECIFICATIONS OF LATEST ISSUE APPLY.  
FOR METHOD OF MARKING, SEE  
NAVORD OSTD-2.

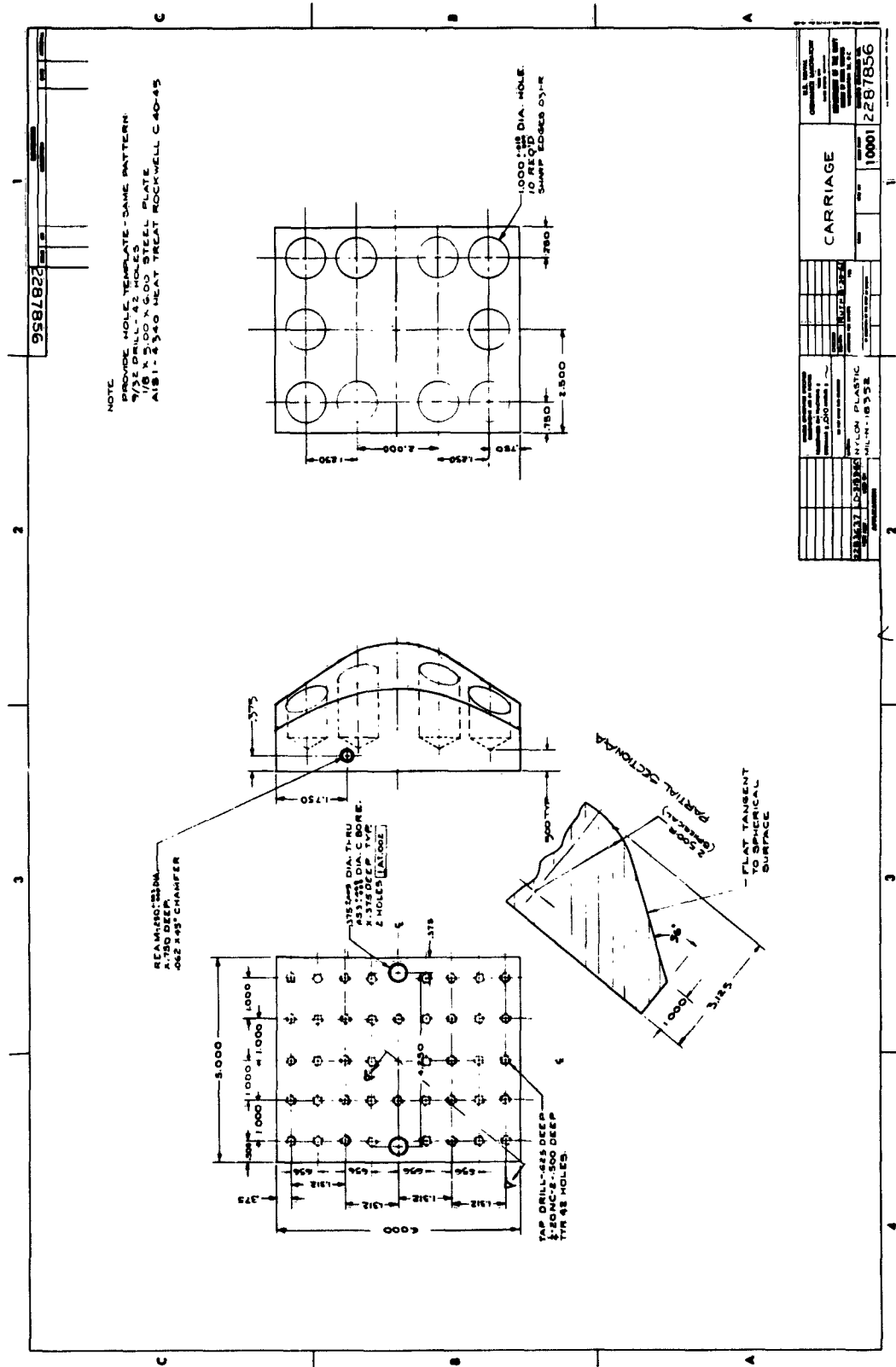


BUREAU OF ORDNANCE DEPARTMENT OF THE ARMY U. S. NAVAL ORDNANCE LABORATORY SILVER SPRING MARYLAND		BUORD DRAWING NO <b>2284259</b>	
TOP ANGLE		SCALE	UNIT WT.
APPROVED		CHECKED	DRAWN
BY		RUTH 6284	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE AS FOLLOWS: FRACTIONS DECIMALS 1/32 0.0015 1/16 0.0030 1/8 0.0060 1/4 0.0120 3/8 0.0240 1/2 0.0480 3/4 0.0720 1 0.1440 2 0.2880 DO NOT SCALE THIS DRAWING		MATERIAL STEEL, AISI 1010-1020 SPECIFICATIONS OF LATEST ISSUE APPLY	
2283354	LD-515960	APPLICATION	
NEXT ASSY	USED ON		

<div style="border: 1px solid black; padding: 5px; display: inline-block;">2284260</div>				<p>2 - REQD.</p>																																													
<p>SPECIFICATIONS OF LATEST ISSUE APPLY; FOR SCREW THREAD STANDARDS, SEE BUSTD. HDBK H-28. FOR METHOD OF MARKING, SEE NAVORD QSTD- 2.</p>		<p>GUIDE ROD</p>		<p>U. S. NAVAL ORDNANCE LABORATORY SILVER SPRING MARYLAND</p>																																													
<p>REVISIONS</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>SYM</th> <th>DESCRIPTION</th> <th>DATE</th> <th>APPROVAL</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		SYM	DESCRIPTION	DATE	APPROVAL																																									<p>19</p> <p>BY DIRECTING OF THE CHIEF OF BUREAU</p> <p>CHECKED <u>RUTH</u> DRAWN <u>2284</u></p>		<p>BUOARD DRAWING NO <b>2284260</b></p>	
SYM	DESCRIPTION	DATE	APPROVAL																																														
<p>UNLESS OTHERWISE SPECIFIED STANDARD DIMENSIONS AND FINISHES SHALL BE IN ACCORDANCE WITH NAVORD QSTD- 2</p> <p>DO NOT SCALE THIS DRAWING</p> <p>MATERIAL <u>STAINLESS STEEL</u> AISI TYPE <u>302</u></p> <p>SPECIFICATIONS OF LATEST ISSUE APPLY</p>		<p>2283354</p> <p>LD-515960</p> <p>USED ON</p> <p>APPLICATION</p>		<p>2283354</p> <p>LD-515960</p> <p>USED ON</p> <p>APPLICATION</p>																																													

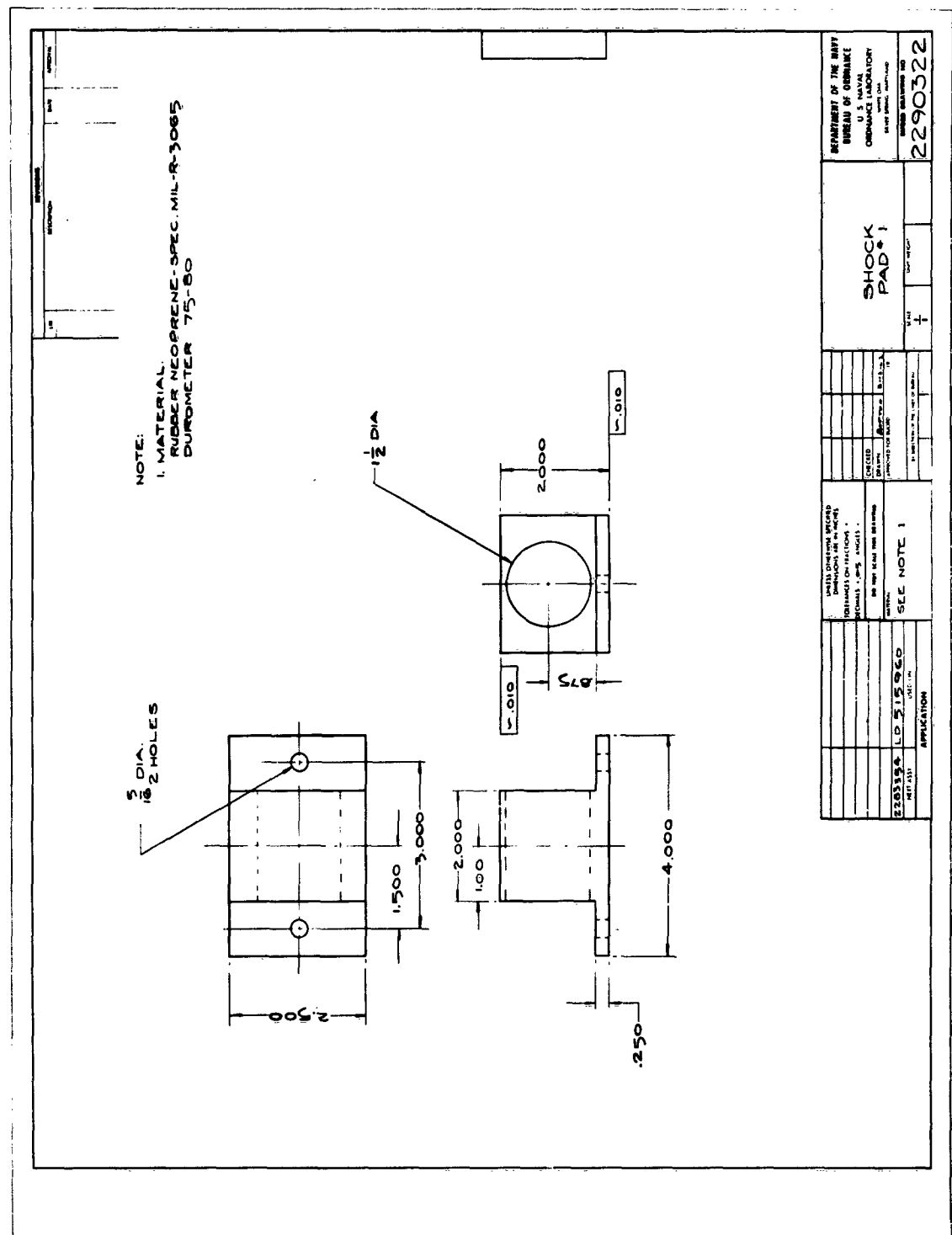
DRAWING SHEET PRINC-NOL-3381 B REV (1-53)

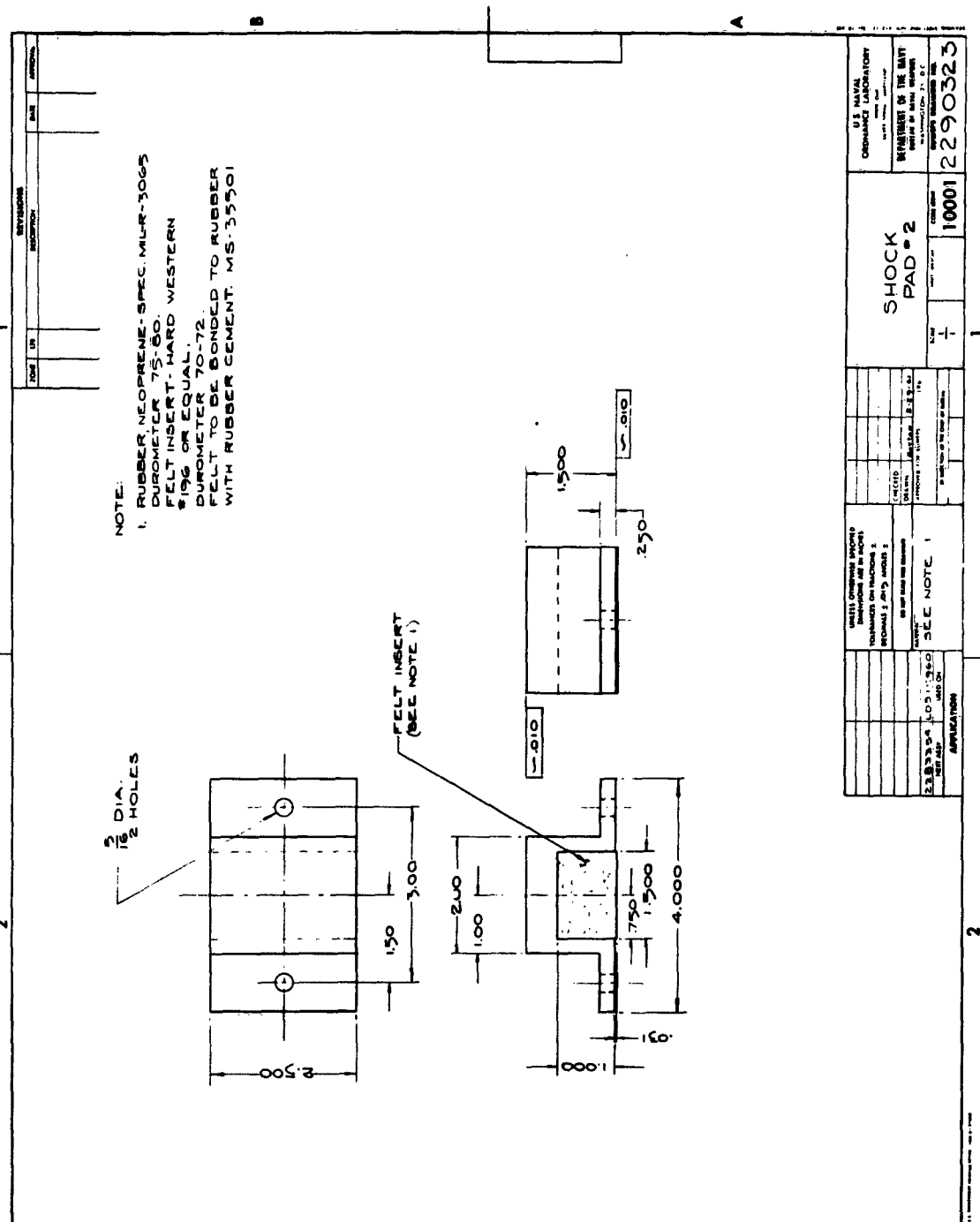
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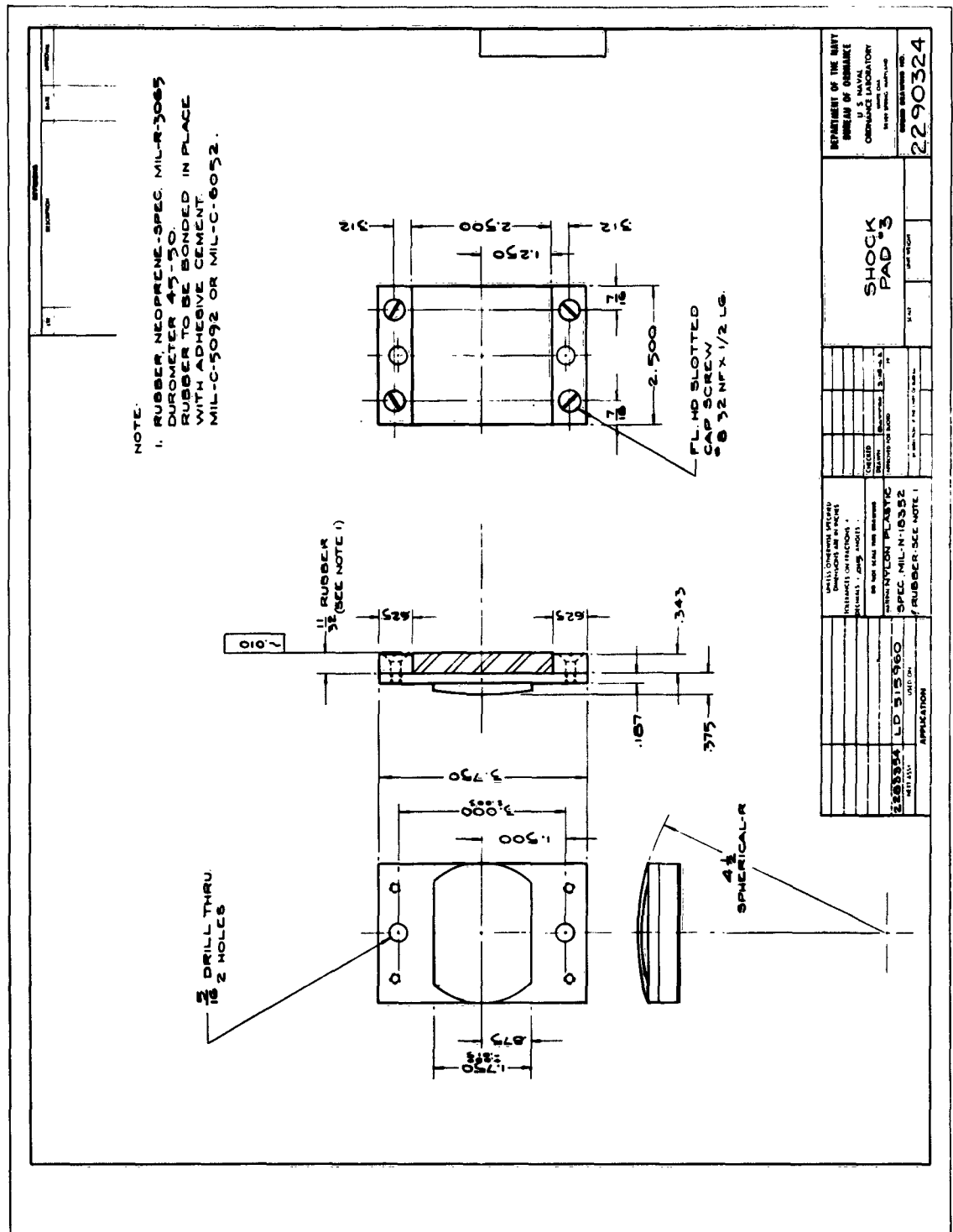


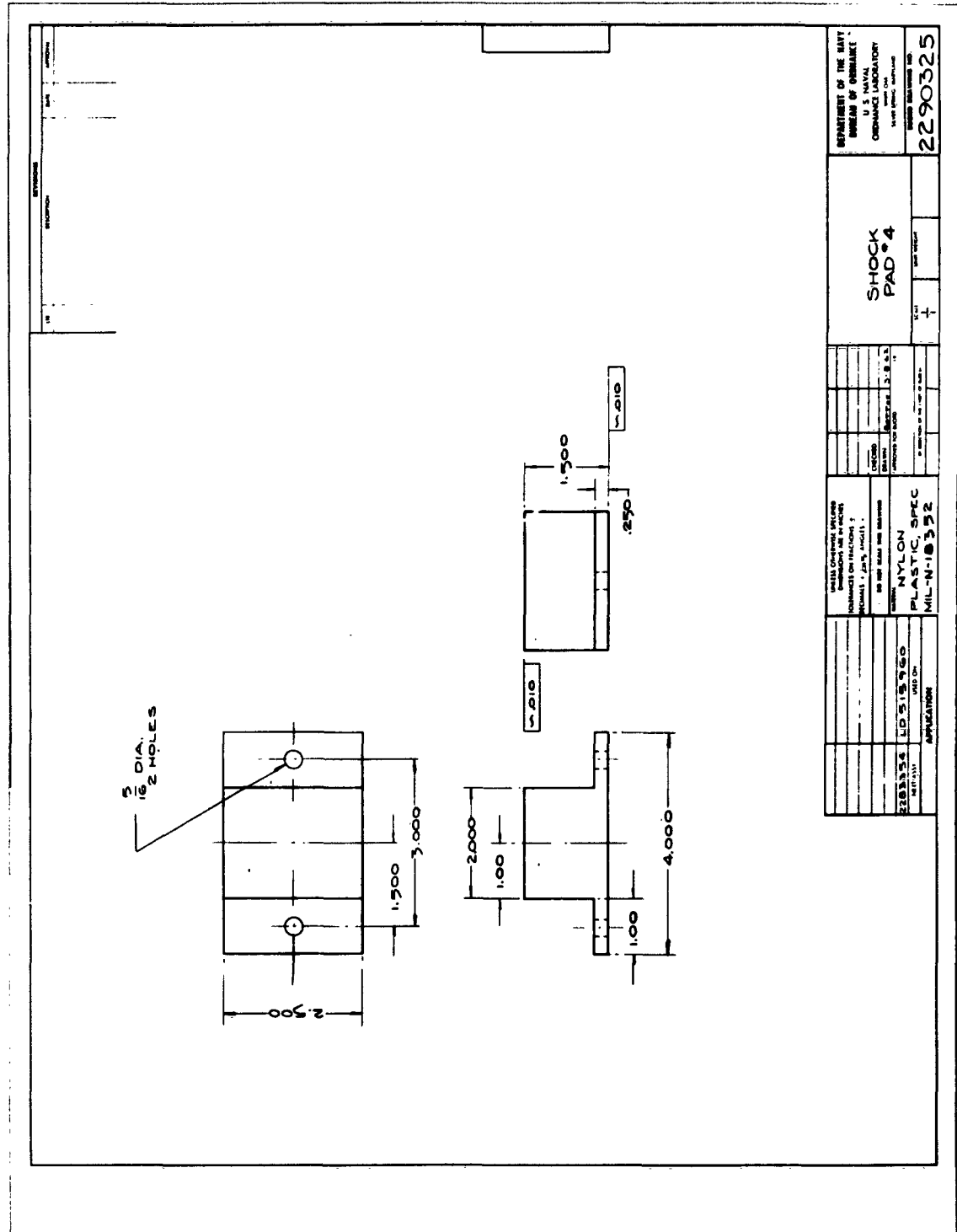
REVISIONS		DATE	APPROVAL
LIT	DESCRIPTION		
<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/16 DECIMALS ± .005 ANGLES ± 1°</p> <p>DO NOT SCALE THIS DRAWING</p> <p>MATERIAL <b>STEEL</b> AISI 1010-1020</p>		<p>APPROVED BY:  DATE: 7-23-54 APPROVED FOR BIDDING</p> <p>IN DIRECTION OF THE COM OF BUREAU</p>	
<p>2283643 LD 515 960 NEXT ASST USED ON</p>		<p>HOOK</p> <p>SCALE 1</p>	
<p>APPLICATION</p>		<p>DEPARTMENT OF THE NAVY BUREAU OF ORDNANCE U. S. NAVAL ORDNANCE LABORATORY 1916 SPRING, BALTIMORE</p> <p>ORDNANCE DRAWING NO. <b>2289500</b></p>	





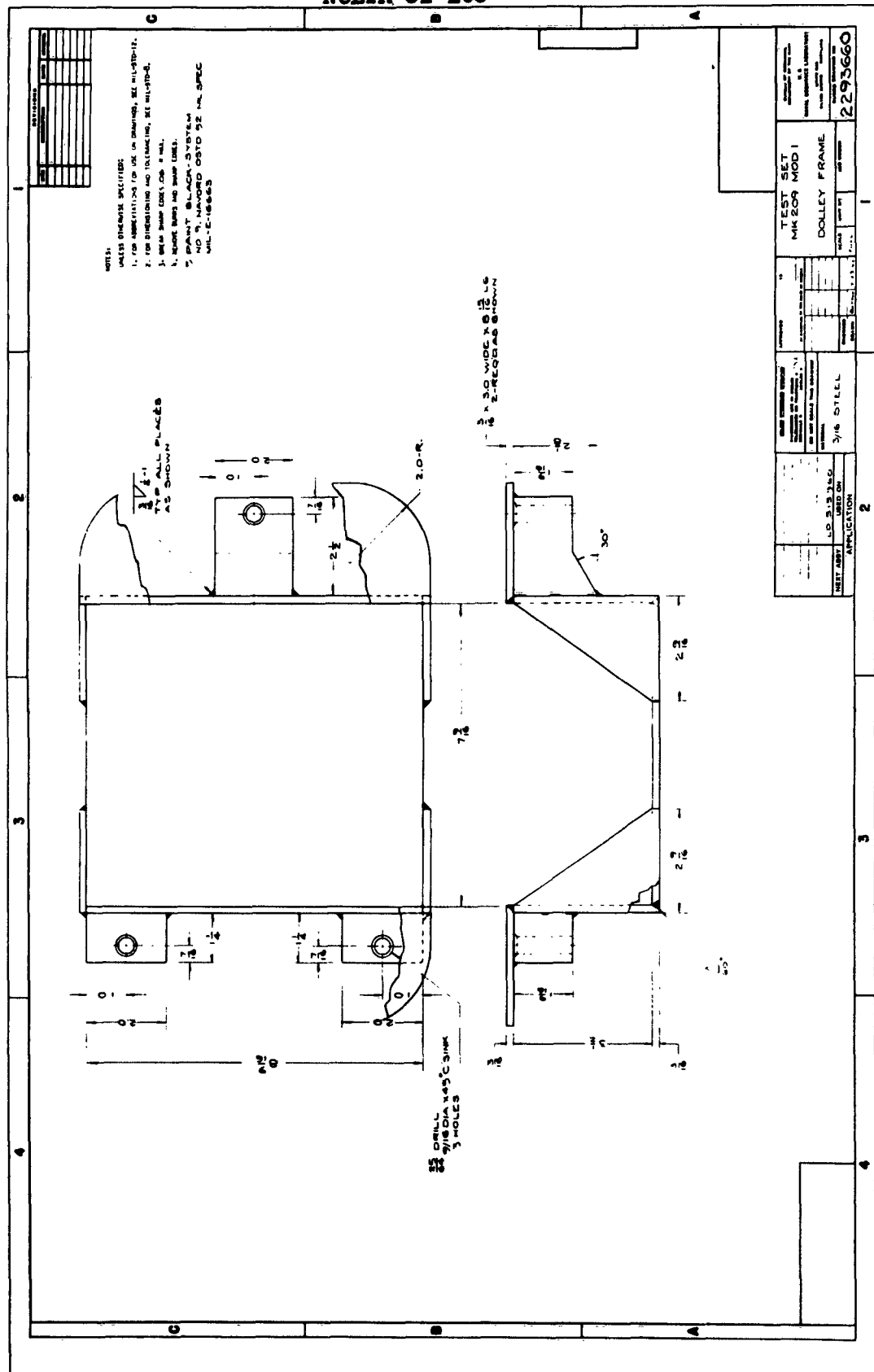












NOLTR 61-106

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U. S. Naval Weapons Laboratory  
Dahlgren, Virginia

BIBLIOGRAPHIC INFORMATION					
	DESCRIPTORS	CODES		DESCRIPTORS	CODES
SOURCE	NOL Technical report	NOLTR		Unclassified - 11	U011
REPORT NUMBER	61-106	610106		CIRCULATION LIMITATION	
REPORT DATE	20 November 1962	1162		CIRCULATION LIMITATION OR BIBLIOGRAPHIC	
				BIBLIOGRAPHIC (SUPPL., VOL., ETC.)	

SUBJECT ANALYSIS OF REPORT			
DESCRIPTORS	CODES	DESCRIPTORS	CODES
Test sets	TESR		
Drop testers	DROS		
WOX	WOX A		
126A	Ø126		
Operation	OPER		
Calibration	CALB		
Shock	SHOC		
Range	RNGE		
Test sets (Design)	TESRD		
Drop testers (Design)	DROSD		
Components	COMO		

1.	Naval Ordnance Laboratory, White Oak, Md. (NOL technical report 61-106) TEST SET, DROP SHOCK, WOX-126A, by V. F. DeVost. 20 Nov. 1962. 18p. illus., charts. Projects HASP, Fame 04002, RUSD 2A 001, RUDC 2C 624, NOL 417, Success, Polaris Mark 2 and SUBROC. UNCLASSIFIED	Testing equipment - WOX-126	1.	Naval Ordnance Laboratory, White Oak, Md. (NOL technical report 61-106) TEST SET, DROP SHOCK, WOX-126A, by V. F. DeVost. 20 Nov. 1962. 18p. illus., charts. Projects HASP, Fame 04002, RUSD 2A 001, RUDC 2C 624, NOL 417, Success, Polaris Mark 2 and SUBROC. UNCLASSIFIED	Testing equipment - WOX-126
2.	Describes portable 70-inch, free-fall drop tester, presents operating instructions, and contains calibration curves. Wide range of shocks are produced with felt, rubber, and plastic impact pads. At maximum drop height and for payloads of 1 lb., shocks range in amplitude from 170 g for softest pad to 3200 g for hardest pad. Duration of these shocks are 12 ms and 0.6 ms respectively. Maximum allowable load for test set is 4 lb. Maximum impact velocity change experienced by carriage is 35 fps.	Testing equipment - WOX-126	2.	Describes portable 70-inch, free-fall drop tester, presents operating instructions, and contains calibration curves. Wide range of shocks are produced with felt, rubber, and plastic impact pads. At maximum drop height and for payloads of 1 lb., shocks range in amplitude from 170 g for softest pad to 3200 g for hardest pad. Duration of these shocks are 12 ms and 0.6 ms respectively. Maximum allowable load for test set is 4 lb. Maximum impact velocity change experienced by carriage is 35 fps.	Testing equipment - WOX-126
3.	UNCLASSIFIED	Calibration	3.	UNCLASSIFIED	Calibration
I.	Title	Drop testers	I.	Title	Drop testers
II.	DeVost, F.		II.	DeVost, F.	
III.	Project		III.	Project	
IV.	Project		IV.	Project	
V.	Project		V.	Project	
VI.	Project		VI.	Project	
VII.	Project		VII.	Project	
VIII.	Project		VIII.	Project	
IX.	Project		IX.	Project	
X.	Project		X.	Project	

1.	Naval Ordnance Laboratory, White Oak, Md. (NOL technical report 61-106) TEST SET, DROP SHOCK, WOX-126A, by V. F. DeVost. 20 Nov. 1962. 18p. illus., charts. Projects HASP, Fame 04002, RUSD 2A 001, RUDC 2C 624, NOL 417, Success, Polaris Mark 2 and SUBROC. UNCLASSIFIED	Testing equipment - WOX-126	1.	Naval Ordnance Laboratory, White Oak, Md. (NOL technical report 61-106) TEST SET, DROP SHOCK, WOX-126A, by V. F. DeVost. 20 Nov. 1962. 18p. illus., charts. Projects HASP, Fame 04002, RUSD 2A 001, RUDC 2C 624, NOL 417, Success, Polaris Mark 2 and SUBROC. UNCLASSIFIED	Testing equipment - WOX-126
2.	Describes portable 70-inch, free-fall drop tester, presents operating instructions, and contains calibration curves. Wide range of shocks are produced with felt, rubber, and plastic impact pads. At maximum drop height and for payloads of 1 lb., shocks range in amplitude from 170 g for softest pad to 3200 g for hardest pad. Duration of these shocks are 12 ms and 0.6 ms respectively. Maximum allowable load for test set is 4 lb. Maximum impact velocity change experienced by carriage is 35 fps.	Testing equipment - WOX-126	2.	Describes portable 70-inch, free-fall drop tester, presents operating instructions, and contains calibration curves. Wide range of shocks are produced with felt, rubber, and plastic impact pads. At maximum drop height and for payloads of 1 lb., shocks range in amplitude from 170 g for softest pad to 3200 g for hardest pad. Duration of these shocks are 12 ms and 0.6 ms respectively. Maximum allowable load for test set is 4 lb. Maximum impact velocity change experienced by carriage is 35 fps.	Testing equipment - WOX-126
3.	UNCLASSIFIED	Calibration	3.	UNCLASSIFIED	Calibration
I.	Title	Drop testers	I.	Title	Drop testers
II.	DeVost, F.		II.	DeVost, F.	
III.	Project		III.	Project	
IV.	Project		IV.	Project	
V.	Project		V.	Project	
VI.	Project		VI.	Project	
VII.	Project		VII.	Project	
VIII.	Project		VIII.	Project	
IX.	Project		IX.	Project	
X.	Project		X.	Project	